SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1912.

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SCIENCE ABSTRACTS.

Section A.—PHYSICS.

AUGUST 1912.

GENERAL PHYSICS.

1139. *The Sperry Gyro-compass.* (Engineering, 93. pp. 722–727, May 31, 1912.)—As in the case of the Anschütz instrument [Abstract No 567 (1911)] the gyroscopic principle is employed, but the Sperry apparatus differs in many ways. There is a master compass, and repeater compasses are placed at suitable points and are controlled by a transmitter; an automatic correcting device is also fitted. The gyro wheel runs at 8600 r.p.m. and is stated to require 204 kv.a. [volt-amps. ?] for running it. The directive force is 204,000 dyne-cm., which is about 291 times greater than that of a 7½-in. floating magnetic compass. The repeater compasses take 10 watts to drive them, and their torque is about 10,000 dyne-cm. The apparatus is illustrated, and a diagram of connections given. L. H. W.

1140. *Apparatus for Making Observations from an Aeroplane.* **Duchêne.** (Comptes Rendus, 154. pp. 1407–1409, May 28, 1912.)—The apparatus, called a "Tourne-Sol," comprises two rotating mirrors combined on the principle of a sextant, enabling the observer to adjust the orientation of the image of any point on the ground which he may be examining, so as to correspond with the orientation of the same point on a plan. The article is illustrated. C. A. B.

1141. *Electric Chronograph with Synchronised Sparks.* **A. Blondel.** (Comptes Rendus, 154. pp. 977–980, April 15, 1912.)—Oscillograph traces are photographed on a moving sensitive film, and the slit or cylindrical lens is illuminated by a controlled electric spark from an induction coil fitted with a synchronised break of the type made by Guillet. C. P. B.

1142. *An Optical Load-extension Indicator.* **W. E. Dalby.** (Roy. Soc., Proc. Ser. A. 86. pp. 414–426, May 8, 1912. Engineering, 93. pp. 781–783, June 7, 1912.)—Describes an extensometer for obtaining autographic diagrams into which the inertia effects of beam and jockey weight in the testing machine cannot enter. A steel weigh-bar is placed in series with the specimen in the machine and is of such quality and dimensions that stresses which will fracture a specimen will not exceed the limit of proportionality of the bar. During a test the jockey is run out permanently to 12 tons, which is the safe load for the weigh-bar. A beam of light is projected on to a small concave mirror which swings about a fixed axis whenever one end of the weigh-bar moves relatively to the other. The ray is reflected from this mirror *via* an inclined plane mirror on to a photographic plate, where it focusses. Thus any extension of the bar causes a motion of the spot horizontally on the plate, proportional to the applied load. The abovementioned plane mirror is mounted on an axle so that it can swing in a vertical plane. This motion is strictly proportional to the extension of a fixed gauge-length of the specimen, and is conveyed by a simple system of links with geometric contact at all the joints. Thus a photographic record is made of loads and extensions on a greatly enlarged scale. The links are arranged to correct angularity errors mutually; the relative motion of the datum points is communicated by surface contact under a constant pressure. The scale can readily be altered, and is a simple function of the dimensions of the instrument. The extension base is calibrated *in situ*, by means of a ladder gauge with rungs ½ in. apart. The top rung is hung on the datum point screw, on which the contact link normally rests, and the latter being placed on the successive rungs and the beam of the machine slightly agitated at each point, a series of index marks are photographed which serve for the diagram to be taken. Load calibration marks are obtained by attaching the weigh-bar between the shackles and balancing for a series of loads, at each point giving a small displacement to the mirror by hand so as to photograph the load lines. A number of specimen diagrams are given for steels and copper. C. A. M. S.

1143. *Equi-density Temperatures of Water and Other Liquids.* **C. R. Darling.** (Phys. Soc., Proc. 24. pp. 222–227, June 15, 1912.)—A drop of aniline will sink in water which is below 64° C., but will rise when the temperature exceeds 64°. Aniline having a greater coefficient of expansion than water, its density diminishes more rapidly, when it is heated, and becomes equal to that of water at 64°. The equi-density temperatures of similarly-behaving substances are: aceto-acetic ether, 54°; isobutyl benzoate, 50°; orthotoluidine, 24°; anisol, 15°. All these liquids expand uniformly between 0 and 80°, at least practically so; the author's liquids were purchased as refined. Some further experiments on the formation of drops and of liquid columns are described. [Compare Abstracts Nos. 588 and 1081 (1911).] H. B.

1144. *New Mechanical Tests of Metals.* **R. Guillery.** (Rev. de Métallurgie, 9. pp. 471–499, June, 1912.)—It has for a long time been considered sufficient to carry out a tensile test—which also gives yield-point, elongation and reduction of area—and occasionally some simple form of shock test, in order to determine the suitability of a metal for industrial use. This method of testing can be advantageously replaced by a method which determines true Brinell hardness, elastic limit and resilience. In the author's system of testing, Brinell hardness is determined by suitably compressing a series of Belleville washers until a force of 3000 kg. is exerted on the test specimen held between the cushion and a 10-mm. diam. ball mounted in the end of a screw which can be moved up and down by means of a divided head, which in turn serves to determine the area of the indentation produced. A smaller, portable machine with a ball 5 mm. in diam. and exerting a force of 750 kg. can be used to verify the homogeneity of finished sections. Elastic limit is determined by moving a truncated cone in the direction of its axis across a ball loaded under a known weight. The groove produced suddenly diminishes in depth owing to the increase of hardness which occurs on exceeding the elastic limit, and from a knowledge of the load and the area at which the increase of hardness occurs, the elastic limit can be calculated. Resilience is determined in the Guillery impact tester [see Abstract No. 717B (1912)]. F. C. A. H. L.

1145. *The Endurance of Metals.* **E. M. Eden, W. N. Rose,** and **F. L. Cunningham.** (Inst. Mech. Engin., Proc. 4. pp. 839–880; Discussion and Communications, pp. 881–974, Oct.–Dec., 1911.)—Tests were made on various steels in alternating stress. The specimens were mounted in a special machine as rolling beams subjected to a uniform bending moment. It was found that rests were unavoidable in some of the tests, though the load was not taken off. These stops, even of considerable duration, had no effect on endurance. The curves of range against number of alternations to fracture are given for a large number of tests at speeds up to 1300 r.p.m. No speed effect is observable, in contradistinction to Reynolds and Smith, who found a reduction of endurance due to an increase from 1300 to 2000 r.p.m., and in accord with Stanton, who found no different effects at 100, 200, and 2200 reversals per min. The authors conclude that endurance is a function of the total number of repetitions and not of their speed. A number of stress-revolution curves are shown plotted logarithmically. Neither they nor the ordinary curves approach the horizontal after one million reversals, and the authors doubt if there is any limiting range of stress as found by Wöhler and other experimenters. The ranges of stress are given which fracture the various steels after one million reversals, and form a basis for comparisons of endurance. The endurance seems to depend more on the tenacity than on the elastic limit. The increased endurance of high tensile steels and reduced ratio (range)/(tenacity) as the tenacity increases, confirm the results of other work. A polished specimen shows greater endurance than one plain turned. Endurance is markedly reduced by scratching and by a V-groove as well as by annealing. In the *discussion,* **W. C. Unwin** referred to the "natural" elastic limits as being neglected in the paper. He strongly affirmed the existence of a limiting range, as did **L. Bairstow,** who drew curves of stresses against reciprocals of reversals to fracture. **C. E. Stromeyer** found no relation between endurance and tenacity or elastic limit. **J. O. Arnold** considered that the Wöhler-effect measured in the paper was only one factor in four governing safety. What was measured was merely a reflection of a varying yield-point. **H. S. Hele-Shaw** drew a close analogy between muscular and metallic fatigue. **C. H. Wingfield** concluded, from comparisons with other tests, that there is a limiting range, which the authors did not reach. The generation of heat due to stressing in Reynolds' and Smith's tests was much more in quantity than in the authors', accounting for the speed effect observed by the former. **B. Hopkinson** described his electrical alternating-stress machine [Abstract No. 628 (1912)]. He considered that endurance was increased at very high speeds. **E. F. Etchells** discussed the factor of safety to include fatigue effects. **B. P. Haigh** wrote describing an a.c. testing machine used in the University of Glasgow. **H. R. Sankey** wrote suggesting the plotting of product of ranges and revolutions on a "revolutions" base. From this he calculated graphically the limiting ranges at one million, ten millions, and infinity. C. A. M. S.

1146. *Friction.* **C[harlotte] Jacob.** (Ann. d. Physik, 38. 1. pp. 126–148, May 7, 1912. Abstract from Dissertation, Königsberg.)—An investigation of the manner in which the coefficient of friction depends (i) on the velocity of the sliding body; (ii) on the atmospheric pressure; (iii) on the dampness and on other surface conditions; (iv) on the temperature. It is shown (i) that the coefficient of friction is a function of the velocity, at first increasing rapidly with the velocity, then slower and slower, finally attaining a practically constant value, which is the value usually determined. (ii) Increase or decrease of the atmospheric pressure within wide limits appears to have no effect on friction. (iii) In general the coefficient of friction (μ) increases with the quantity of moisture, ether or alcohol vapour present, but an alkali-free glass showed no variation of μ with the amount of moisture present. (iv) With increasing temperature, the value of μ for the materials dealt with (glass) at first decreases, reaching a minimum value at about 150° to 200° C. of about ½ to ⅓ the value at summer temperature, after which it increases rapidly. A. W.

1147. *Sealing Metals.* **P. E. Shaw.** (Phys. Soc., Proc. 24. pp. 95–97; Discussion, p. 98, Feb., 1912.)—To fasten glass, aluminium, or quartz surfaces to any other Threlfall used Margot's solder (92 per cent. Sn, 8 per cent. Zn). The author finds that in place of Margot's solder, the following act very well: Tin, zinc, various alloys of tin and zinc, tinman's solder, aluminium. Besides, there are a variety of materials with melting-points between 180° and 660°. For these and like materials which act in the same manner as sealing-wax the author suggests the term "sealing-metals." They have the advantage over any wax in high melting-point and non-emission of vapour when the temperature is raised. There are many applications for sealing-metals other than for suspending fibres or wires. J. J. S.

1148. *Capillary Phenomena in Fusing Wires.* **E. L. Lederer.** (Akad. Wiss. Wien, Ber. 121. 2a. pp. 17–23, Jan., 1912.)—A wire which is fused by an electric current breaks up into a series of beads or assumes the shape of a rod whose thickness varies in regular undulations. The phenomena are essentially due to surface tension as in the case of an isolated cylinder or ring of liquid which, according to Plateau, is unstable if its length exceed the circumference [compare Worthington, Abstract No. 638 (1912)]. In the case of fusing wires thermal conductivity, radiation and oxidation enter in addition to surface tension; but the demonstration is easier with wires than with liquids. The experiments succeed best with copper wires of 0·165 mm. diam.; the wire melts at some spot or at two spots, and the drooping end assumes the beady appearance. Calculations are based upon Plateau and upon A. Beer (Theory of elasticity and capillarity, 1869). H. B.

1149. *Capillary Filaments.* **H. S. Souttar.** (Phys. Soc., Proc. 24. p. 166; Discussion, p. 167, April, 1912.)—Describes a method of making fine glass capillary filaments suitable for the fibres of a string galvanometer. The essential part of the apparatus used is a small box of mica, between the upper and lower plates of which a fine Pt-wire is strung backwards and forwards so as to form a small cage enclosing a cylindrical space 1 cm. in diam. and 2·5 cm. deep. A small glass tube is hung in the centre of this electric furnace and supports a small weight. As the glass softens the weight falls, and the glass is drawn out into a fine capillary. Heating is limited to a minute portion of the glass tube by a copper tube (surrounding the glass) which extends down a short distance into the furnace. The weight is a long light rod with a disc on its lower end which nearly fits a tube into which it falls. The tube is filled with a mixture of glycerine and water, so that the weight falls smoothly and evenly till it reaches a stop. With this appliance a tube of 1 mm. external diam. can easily be drawn into a tube of any length and of a diam. of 0·001 mm., with a wall of less than 0·0001 mm. in thickness. The thick ends remain attached to the filament, and so it is easy to manipulate, Such filaments are very light and strong, 10 cm. length weighing roughly 0·1 mgm., and being capable of supporting at least 0·05 gm. They are easily silvered, and the resulting conductor has a low resistance. In the *discussion*, it was stated that the filaments were somewhat tapered, the upper end being the thinner, with an extreme variation in diam. of 50 per cent.

A. W.

1150. *Pore Diameters of Osmotic Membranes.* **F. E. Bartell.** (Journ. Phys. Chem. 16. pp. 818–835, April, 1912.)—Although most grades of porcelain do not produce apparent osmotic effects when tested as diaphragms, there are a few grades which do so. Preliminary experiments having shown that the production of osmotic phenomena is probably dependent on the size of the pores in the porcelain, the author has measured the pore diameters in different porcelains, at the same time observing their action as diaphragms. The pressure required to force water out of a (porcelain) membrane saturated with water was determined, and from the results the diam. of the pores estimated. In many cases the pores were clogged with insoluble precipitates (S, $BaSO_4$, $PbCrO_4$, $PbSO_4$, CuS and $Cu_2FeC_6N_6$) which were generally made by direct precipitation in the porcelain. A definite area (1·54 cm.^{2}) was investigated in every case. It was found that when there were 100–125 pores in this area, with diams. greater than 0·923 μ, no osmotic effects were obtained. The border-line between osmotic effect and no osmotic effect seems to be practically the same for membranes clogged with insoluble crystalline precipitates and for those clogged with the so-called "semi-permeable" precipitates. [See Abstract No. 226 (1910).]

T. S. P.

1151. *Internal Agitation of Liquid Crystals.* **C. Mauguin.** (Comptes Rendus, 154. pp. 1359–1361, May 20, 1912.)—When examined with a powerful light, a film of liquid-crystal is seen not to be completely uniform, *i.e.* the "extinctions" do not affect the whole film, but only certain portions of it. The film is resolvable into swarms of minute black and white specks of intense and rapid agitation. It is suggested that this effect is caused by the oscillation of the units about the mean position of the optic axis. This effect can be controlled by a magnetic field which arrests the motion and renders the field homogeneous. A new example of the liquid-crystalline state is quoted, which gives homogeneous films without the assistance of the magnetic field.

T. M. L.

1152. *Terminal Velocity of Small Spheres in Air.* **L. W. McKeehan.** (Phys. Rev. 33. pp. 153–172, Sept., 1911. Phys. Zeitschr. 12. pp. 707–721, Sept. 1, 1911.)—As the result of the further experiments here described, made at various low pressures, the formula of Zeleny and McKeehan [Abstract No. 885 (1910)], when multiplied by the term $(1 + Al/a)$ is found to express the end velocity of fall over a wide range of radii and pressures. In this formula a is the mean free path of the gas molecules, and A is a constant whose experimental value is $1·00 \pm 3$. Theoretically A, for elastic impact equals 1·5; for non-elastic impact and the same distribution of the velocity components in the case of the emergent as in the entering molecules, A = 1·2; for non-elastic impact and normal emergence of the molecules, A = 1·05. [See also Abstract No. 432 (1912).] L. H. W.

1153. *Viscosity of Gases.* II. **G. Zemplén.** (Ann. d. Physik, 38. 1. pp. 71–125, May 7, 1912.)—In this paper experiments are described in which very small and very large velocities of rotation of the sphere were employed. [See Abstract No. 1680 (1909).] The moment of the viscous forces of the gas was theoretically developed in the form of a series containing higher powers of the gas velocity. The moment was also determined experimentally for a large number of cases with periodic times of revolution of the sphere varying from 0·1 sec. to $2\frac{1}{4}$ hours, air and CO_2 being the gases employed. From the results obtained, it appears that the limit set by Rayleigh and Lamb, within which the simple Kirchhoff formula is applicable, is too low, and lies at a 500 times greater velocity. At no time was a discontinuous change in the motion remarked, such as Reynolds observed in the case of water flowing through tubes, and turbulent motion in the latter case is ascribed to the disturbing action of the ends of the tube, an effect which is absent in the case of the spherical layer of gas. The moment of the viscous forces per unit of velocity has a feeble but definite minimum which is probably due to slipping. G. E. A.

1154. *Stability of Cellular Vortices.* **C. Dauzère.** (Comptes Rendus, 154. pp. 974–976, April 15, 1912.)—On repeating certain of the experiments described by Bénard [see Abstract No. 798 (1912)], with slight modifications in the method of warming the thin layer of liquid, a series of *tourbillons* were obtained of remarkable stability. They are likened to the appearances presented during the progress of certain fermenting processes. **H. Deslandres.** (Ibid. 976–977.)—Deslandres draws attention to the similarity of these cellular formations to the lunar craters and other features. The formations may also furnish useful information with regard to the movements of the solar atmosphere as portrayed by spectroheliograph records. C. P. B.

1155. *Quarternionic Form of Relativity.* **L. Silberstein.** (Phil. Mag. 23. pp. 790–809, May, 1912.)—In 1854 Cayley showed that the rotations in a four-dimensional space might be effected by means of a pair of quarternions applied, one as a prefactor and the other as a postfactor to the quarternion q, whose components are the four co-ordinates of a space point, say $q' = aqb$...(1), where in the case of pure rotation a and b must be either *unit* quarternions, or at least such that $T^2a \,.\, T^2b = 1$; T being the tensor. On the other hand, it is widely known that the so-called Lorentz-transformation of the union of ordinary space (x, y, z) and time (t), which is the basis of the modern theory of relativity, corresponds precisely to a (hyperbolic) rotation of the four-dimensional manifoldness (x, y, z, t), or of what Minkowski calls the "world." These two facts suggested the idea of representing explicitly the Lorentz-transformation in the quarternionic shape, which, together with some allied questions, forms the subject of the present paper. To solve the problem Einstein's formulæ are put in vector form, the triple product in (1) is developed and the two compared. The actual analysis then occupies the bulk of the paper, but does not lend itself to abstraction. E. H. B.

1156. *Detecting the Proximity of Ice at Sea.* **M. Coplans.** (Nature, 89. p. 295, May 23, 1912.)—The electric conductivity of sea-water decreases by about 2 per cent. per 1 deg. C. when the temperature sinks below 20° C., and dilution with fresh water (from icebergs) also reduces the conductivity by 1 per cent. in the presence of 1 part of ice-water in 80 of sea-water, by 3 per cent. in a dilution of 1 : 50, by 7 per cent. in a dilution of 1 : 25, by 12 per cent. in a dilution of 1 : 12. These effects might be utilised; apparatus are not suggested. H. B.

1157. *Dust Layers in the Atmosphere and Changes in the Neutral Points of Sky Polarisation.* **W. J. Humphreys.** (Mount Weather Observatory, Bull. 4. pp. 397–401, 1912.)—The author commences with a brief explanatory note on the nature of the neutral points of sky polarisation, and then quotes some conclusions arrived at by Süring as to the movements of these points when the sun reaches certain defined angles below the horizon. Süring considers that these rapid changes in the positions of the neutral points are attributable to distinct layers of some sort in the atmosphere. The author of the present paper points out that three definite dust layers are to be expected in the atmosphere, and that these layers will account for the movements of the neutral points which have been observed. J. S. Di.

1158. *Echelon Clouds.* **W. J. Humphreys.** (Mount Weather Observatory, Bull. 4. pp. 409–413, 1912.)—This is a note on certain clouds which appear to an observer on the earth's surface to resemble a flight of stairs. It is suggested that this appearance is produced by a series of fairly regularly spaced cumulus clouds having plane bottom surfaces at a uniform height. These non-illuminated bottoms are then seen alternately spaced with the brightly lighted vertical sides, so producing a staircase effect. Certain conclusions are arrived at as to the temperature and humidity conditions which must prevail when these clouds are seen. The subject is illustrated by a photograph and diagram. J. S. Di.

1159. *Winds in the Upper Atmosphere at Batavia.* **W. van Bemmelen** and **J. v. Hann.** (Meteorolog. Zeitschr. 29. pp. 145–150, April, 1912; after Magn.-Meteor. Observatory, Batavia, 1911, No. 1.)—The observations were taken by means of pilot ballons, of which 324 reached a height of 0·5 km., 107 a height of 10 km., 23 of 15 km., and 3 of 19 km. The wind velocities increase with increasing elevation from about 3 m./sec. to 17 m./sec. at the elevation 14 to 17 km., but the amount of air really transported by the wind decreases owing to the decreasing density. The winds at Batavia are mainly controlled by the Australian Continent climate. In the southern summer the west monsoon may extend up to 7 km. (D. S. Figee); in the winter the south-east trade prevails, which in the higher strata turns more and more into the anti-trade from north-east, as indicated by the cirrus clouds. There are no temperature data available for the elevation 10 to 12 km. The velocity of this anti-trade ranges from 6 m./sec. (October) to 16 m./sec. (Dec. to Feb.). Above this anti-trade follows the "upper trade" (generally from the east, also from the west and south, but not from the north), which Benson first observed in equatorial Central Africa. H. B.

1160. *Rock Temperature in a deeply-overlaid Tunnel.* **E. Lauchli.** (Eng. Record, 65. pp. 620–622, June 8, 1912.)—The author has previously outlined the method used for determining the rock temperature in long and deeply-overlaid tunnels [see Abstract No. 1098 (1911)]. The present paper gives the results of a study for such a tunnel 6 miles long to be driven through the

Continental Divide, Colorado, on the Denver, North-Western and Pacific Railway. It is seen from the temperature and profile curves that the prognosticated rock temperature in the tunnel bears a close relation to the form of the profile of the range penetrated. The effect on the rock temperature of an assumed spring is noticeable a considerable distance away from the spouting point. If when driving the tunnel the rock temperature is recorded, say every 500 ft., a drop in the temperature below a certain limit will surely indicate nearby water, and due precaution can be taken to avoid disaster. Additional data are given bearing on geothermic gradients. A. W.

1161. *Atmospheric Ozone.* **H. N. Holmes.** (Amer. Chem. Journ. 47. pp. 497–508, June, 1912.)—The starch-potassium iodide reaction is given by ozone, hydrogen peroxide, and nitrogen peroxide. In the presence of ferric sulphate the effect of hydrogen peroxide is much accelerated, and there are special tests for nitrogen peroxide. The atmosphere as a rule contains only sufficient ozone to give the starch reaction; hence the starch reaction may be used for the ozone test in the atmosphere. The max. amount of ozone is found when rapidly-moving areas of high barometer are so near the observer that quantities of air from great heights rapidly flow down to the earth. Most of the ozone is produced by the solar ultra-violet rays of the upper atmosphere; thunderstorms are of minor importance. H. B.

1162. *Electrodynamic Method of Investigating the Earth's Crust.* **H. Löwy** and **G. Leimbach.** (Phys. Zeitschr. 13. pp. 397–403, May 1, 1912.)—This paper forms an extension to the investigations previously carried out by the authors [see Abstract No. 1576 (1910)]. The object of the experiments was to localise the position of conducting masses in the earth, such as underground water. The method employed was that previously adopted. A transmitting and-receiving wireless station were set up in two pit shafts, the distance between the two stations being varied. Resonance curves were taken with the receiving station at 820 m. and at 1040 m. from the transmitting station. When superposed the minimum points on the resonance curves do not coincide. The alteration in the form of the resonance curves are due to extinction or interference. From the results obtained the authors develop formulæ for localising the position of the reflecting surface. H. H. H.

1163. *Solar Eclipse of April* 17, 1912. **H. Deslandres.** (Comptes Rendus, 154. pp. 1019–1025, April 22, Erratum, p. 1196, April 29, 1912.)—The programme of observations during the eclipse included spectroheliograph records of the three layers of the chromosphere and direct photographs of the eclipsed sun. The large spectroheliograph was operated with the green coronium line, the smaller instrument with the calcium line K, and the *spectrohéliographe polychrome* with a composite band of radiation, with the idea of recording those portions of the chromosphere which are regarded as made up of particles as contrasted with the general gaseous parts. At Grignon the eclipse was annular, and from the difference in appearance of the two limbs it appears that the station was north of the central line. At Meudon the green coronal ray was seen at the western end of the solar equator, but not at the eastern limb, so no measures of coronal rotation could be made. Where seen, the ray was feeble, unsymmetrical, and sharply degraded towards the red. Several photographs of the flash spectrum were obtained showing numerous bright lines. With the spectroheliograph several prominences were photographed, the positions and heights of these being given.

Stéfanik. (Ibid. pp. 1064–1065, April 22, 1912.)—Observing at Cormeilles-en-Parisis with a 15-cm. refractor, a direct-vision spectrograph, and a photographic camera, special efforts were made to obtain records of the corona. A special green screen was placed in front of the plate, and two exposures given of about 0·5 sec. duration. Only a small extent of the inner corona was photographed. **J. Baillaud.** (Ibid. pp. 1281–1283, May 13, 1912.)—By means of a photographic spectrophotometer an attempt was made to determine the changes produced by the eclipse in the continuous spectrum of daylight. Evidence was obtained that the light was decidedly redder near beginning and ending of eclipse than at other times. Subsequent observations show that by masking the sun's image with suitable diaphragms, the limb of the sun is relatively redder than the central portion, but that the difference varies from day to day. **F. Croze** and **G. Demetresco.** (Ibid. pp. 1284–1286, May 13, 1912.)—Large scale apparatus was employed to obtain photographic records of the prominences and inner corona. The camera was of 21 cm. aperture and 10 m. focal length, and three plates were exposed. Numerous prominences were photographed, their positions and heights being tabulated. **W. H. Julius.** (Konink Akad. Wetensch. Amsterdam, Proc. 14. pp. 1195–1198, May 23, 1912.)—Observations were made near Maestricht, the sky being exceptionally clear. From the positions of contacts and photographs it is concluded that the station was very near the central line. With an objective prism spectrograph Nijland secured spectrograms showing the hydrogen and calcium lines as complete chromospheric rings. Measurements of radiation were made with a thermopile and also with a bolometer, adjusted directly to the sun without lenses or mirrors. One interesting result is that during the eclipse the curve of radiation passed through a sharp minimum showing that the resultant intensity was less than 1/5000 that of the uneclipsed sun. Part of this would, of course, be due to the ring of photosphere still visible at mid-eclipse. C. P. B.

1164. *Spectrum of Comet Brooks* (1911*c*). **A. de la Baume Pluvinel** and **F. Baldet.** (Comptes Rendus, 154. pp. 1286–1288, May 13, 1912.)—During the period of visibility of the comet, 22 good spectrograms were secured with a prismatic camera of special design. Important changes in the spectrum were noticed as the distance from the sun varied; these features were, however, confined to the nucleus only. There is evidence that lines of sodium, and perhaps of iron, became stronger in the spectrum as the comet approached the sun. Also, as the sodium became stronger the Swan carbon spectrum diminished in intensity. The negative pole spectrum of nitrogen was apparently absent from the spectrum of this comet. C. P. B.

1165. *Spectrum of Nova Geminorum* (1912). **F. Iñiguez.** (Comptes Rendus, 154. pp. 962–964, April 15, 1912.)—An excellent series of spectra of the Nova has been secured at the Madrid Observatory, extending from March 16, every evening except March 21 and 30, when the sky was cloudy. On the 23 plates obtained the notable changes in the spectrum from time to time are clearly discernible. Most of the spectra were taken on Agfa Isorapid plates, sensitive only to the blue and violet, so that nothing is shown less refrangible than H_β. On several plates the bright hydrogen lines show distinct evidences of self-absorption, and on the 18th and 19th of March the red sides of the bright lines are much stronger than the violet sides. The bright calcium line K disappeared on March 20. From March 24–27 the bright bands are more intense on their violet sides, while on the 27th and

28th they are more uniform, but a fainter band is seen on the red side. After the 29th all the bands have again the red side strongest, as was seen on the 18th and 19th March. On March 31 the bands H_γ and H_ϵ show evidence of absorption. The intensity of the radiations appeared to increase from the apparition until March 24, and then gradually to diminish. The breadth of the bright bands sometimes exceeded 24 Å. Specially noticeable were the changes of a band near λ4630. The absorption bands have been subject to enormous modifications. Always to the violet side of the emission bands, they have appeared at different distances at different times. On March 20 the absorption bands of H_γ and H_δ appeared reversed, a bright band being distinctly visible. This persisted until the 25th, and in certain cases was perceptible on April 8. In general the absorption bands are wide and diffuse, but in some cases they are very fine. Numerous changes in the intensity of the continuous spectrum are also described. **J. Bosler** and **P. Idrac**. (Comptes Rendus, 154. pp. 961–962, April 15, 1912.)—Observations with an objective-prism camera of 0·25 m. aperture and 0·75 m. focal length, were obtained on March 22 and 28, with exposures of 10 and 18 min., and also on April 4 and 7, with exposures of 35 and 70 min. During the later period the star was fainter than the 6th magnitude. The spectra show the complete series of bright hydrogen lines, accompanied by dark lines on their violet sides and continuous spectrum extending to λ3650. On the plate of April 7 lines are seen at λλ580, 565 and 560 in addition to the prominent line at λ460. C. P. B.

1166. *Gravitational Explanation of "Two Stream" Theory.* **H. H. Turner.** (Roy. Astronom. Soc., M.N. 72. pp. 387–407, March, 1912.)—An attempt is made to explain the "two-drift" phenomenon of stellar motions by simple gravitational motion to and from a centre of the component elements of a stellar cosmos. As stated, the idea is that of a vibrating system, involving recurrences to an initial state at periodic intervals. If the general formation is ellipsoidal, and not spherical, these periods should be existent. Stars with different velocities would conceivably be of different spectral types, as the physical and chemical constitution of the primitive nebula would tend to be modified from centre to surface. Thus stars near the centre might condense into larger masses, and take longer to complete the stages of their life-history. These would have small velocities. An analysis is then made of various groupings and the results are compared with our present knowledge of celestial structure, reference being made to the work of Plummer on globular clusters and the distribution of intrinsic magnitudes. The idea of radial movement, as opposed to the angular motion postulated by Laplace, is developed to explain the phenomena of new stars as caused by explosive pressure when the nebulous matter accumulates at the centre of attraction. This involves the reappearance of Novæ, which future observations only can confirm or disprove. C. P. B.

1167. *Electric Driving Mechanism for Telescopes.* **J. Rheden.** (Zeitschr. Instrumentenk. 32. pp. 185–190, June, 1912.)—Description, with illustrations, of an electric motor coupling for regulating the driving mechanism of telescope mountings. C. P. B.

1168. *Temperature Regulator for Stellar Spectrograph.* **M. Hamy.** (Comptes Rendus, 154. pp. 1128–1131, April 29, 1912.)—Description of a mercury-creosote thermostat for regulating the temperature of the large stellar spectrograph used with the Equatorial Coudé at the Paris Observatory. It is stated that the temperature can be maintained constant to 1/100 deg. C. C. P. B.

1169. *The Hardness of Glass.* **A. Föppl.** (K. Bayer, Akad., München, Ber. 3. p. 505, 1911. Zeitschr. Instrumentenk. 32. p. 211, June, 1912. Abstract.)—An account is given of experiments on the resistance to compression and percussion of various specimens of Jena glass in the form of cubes. J. J. S.

1170. *Is the Ether Superfluous?* **P. Ehrenfest.** (Phys. Zeitschr. 13. pp. 317–319, April 15, 1912.)—A critical examination of Einstein's relativity theory, in which the present author shows difficulties in the way of treating the ether as unnecessary. [See Abstract No. 5 (1912).] E. H. B.

1171. *Minkowski's Equations of Motion and Planck's Dynamics.* **K. Schaposchnikow.** (Ann. d. Physik, 38. 1. pp. 239–244, May 7, 1912.)—Mathematical. [See Abstract No. 1990 (1908).] E. H. B.

1172. *Different Internal Energies of a Substance.* **R. D. Kleeman.** (Cambridge Phil. Soc., Proc. 16. No. 6. pp. 540–559, April 22, 1912.)—The author shows that the internal energy of a substance can be divided into three parts, viz.: (1) the kinetic energy of the molecules due to their motion of translation, (2) their internal molecular energy, and (3) the potential energy due to their attraction upon one another. Various formulæ involving these parts are deduced. E. M.

1173. *Molecular Frequencies.* **M. Born** and **T. v. Kármán.** (Phys. Zeitschr. 13. pp. 297–309, April 15, 1912.)—A mathematical paper in which is discussed the dynamics of the molecules composing a diffraction grating, use being made of the Einstein theory of specific heat. [See also Abstracts Nos. 883, 1389 (1910); 1172, 1524 (1911).] A. W.

1174. *Propagation of Periodic Ether Disturbance.* **A. Stephenson.** (Phil. Mag. 23. pp. 809–813, May, 1912.)—A mathematical discussion, on the elastic solid theory of the ether, of the propagation in it of periodic disturbances. Reflection and refraction at the surface of a crystal are also dealt with. E. H. B.

1175. *Gravitation.* **A. Einstein.** (Ann. d. Physik, 38. 2. pp. 355–369, May 23, 1912.)—Discusses the statics of the gravitation field and the speed of light on the relativity principle. [See Abstract No. 785 (1912).] E. H. B.

1176. *Demonstration of the Movements of Semi-oily Liquids on a Water Surface.* **C. R. Darling.** (Phys. Soc., Proc. 24. pp. 228–229, June 15, 1912.)

1177. *Atmospheric Electricity and Meteorology.* **A. Ansel.** (Gesell. Wiss. Göttingen, Nachr., Math. Phys. Klasse, 1. pp. 76–111, 1912.)—Observations of electric potential, radio-activity, and the usual meteorological data were made in Iceland during the passage of Halley's comet, May–June, 1910. The results are given in detail. C. P. B.

1178. *Determination of Astronomical Positions.* **C. Runge.** (Gesell. Wiss. Göttingen, Nachr., Math. Phys. Klasse, 1. pp. 31–41, 1912.)—Method of determining the astronomical position from solar or stellar altitudes from balloons and ships. C. P. B.

1179. *Analogy of Flame Phenomena with Comets.* **J. Meunier.** (Comptes Rendus, 154. pp. 1156–1159, April 29, 1912.)—In studying the appearance of the flames produced by jets of various types, forms have been noticed which suggest similarity to those presented by certain types of comets, and it is suggested that the cometary phenomena may be due to combustion. C. P. B.

LIGHT.

1180. *New Precision Colorimeter.* **P. G. Nutting.** (Washington Acad. Sci., Journ. 2. pp. 183–185, April 4, 1912.)—The colorimeter here described is a monochromatic analyser designed to be a practical working instrument of wide range, high precision, and utmost simplicity. It is so arranged that light of a pure spectral hue may be mixed with white light to match the unknown, or, in the case of purples, mixed with the unknown to match white. The match is made with a Lummer-Brodhun photometer cube, which is inserted between the prism and telescope of an ordinary spectroscope with pinhole ocular. The white and unknown lights enter through two additional collimators at the side, one of which is directed at the prism, the other at the photometer cube, the entering light being thence reflected along the telescope axis. For the purpose of varying the intensity, each of the side collimators is provided with a pair of rotating nicols just inside the slit. Wave-lengths are varied by rotating the collimator of the spectroscope, which has a bilateral slit. After a match has been secured, the wave-length of the dominant hue is read off either from the position of the collimator, or by throwing in a small hand spectroscope before the pinhole ocular of the telescope. Intensities may be determined by interposing between the cube and telescope a white 180° Whitman rotating disc illuminated by a standard lamp. This gives, in candle-metres, the intensity of each of the three component beams separately. Instead of this flicker photometer arrangement, a simple equality-of-brightness photometer may be used to determine the relative brightness of any two beams. A. E.

1181. *Reflection Coefficients.* **J. T. Tate.** (Phys. Rev. 34. pp. 321–332, May, 1912.)—The reflection method of determining optical constants consists in a polarimetric analysis of the ellipticity and rotation produced in plane-polarised light by reflection from the surface of the medium under investigation. The results obtained from different specimens differ considerably, and the values observed depend on the state of polish and purity of the surface. The object of the author's present investigation was to compare the reflection coefficients computed from the optical constants obtained polarimetrically with the reflection coefficients actually observed on the same surface. Observations were made on a number of different substances, with both polished and unpolished surfaces, the magnitude of whose reflection coefficients varied between wide limits (0·12 to 0·96). The reflection coefficients, photometrically measured, agreed in all cases within the experimental errors with those theoretically determined from polarimetric measurements on the same surface. The greatest deviations usually occurred in the violet, where the small intensity made accurate observations difficult, and on the steepest slopes of the curves. J. J. S.

1182. *Selective Reflection, Scattering and Absorption by Resonating Gas Molecules.* **R. W. Wood.** (Phil. Mag. 23. pp. 689–714, May, 1912. Phys. Zeitschr. 13. pp. 353–368, May 1, 1912.)—This paper deals with phenomena never, up to the present, experimentally investigated, though elaborate mathematical treatments have been given by Planck, Rayleigh, Schuster, Lamb, and others. Through the discovery that the vapour of mercury, at room temperature, emits a brilliant resonance radiation when stimulated by monochromatic ultra-violet light of wave-length corresponding exactly to that of its so-called absorption line (λ = 2536), the author has been able to obtain quantitative data on the subject. It has been found that when the vapour is in a high vacuum there is no true absorption, the energy diverted from the primary beam of light being wholly scattered, as imagined by Planck in his treatment of the theory of absorption. The presence of a small quantity of air or other gas has been found to introduce the factor of true absorption, or the conversion of the energy of the light-waves into heat, and the ratio of the amount of energy scattered to that absorbed as a function of the pressure of the gas, with which the mercury vapour is mixed, has been determined. A very remarkable secondary resonance radiation of the gas not directly illuminated by the primary beam, but stimulated by the light which comes from the directly-excited molecules, has been discovered, the study of which has led to the conclusion that there is no true absorption except when the pressure is raised by the presence of air. The author has also succeeded in passing by gradual stages from the condition in which the resonance radiation is diffusely scattered to that in which, owing to the proximity of the molecules, it is regularly reflected from the surface of the gas mass. A resonance lamp has been constructed which emits light probably more homogeneous than that obtained from any source hitherto known, by the light of which photographs have been obtained of the vapour rising from a drop of warm mercury into the air of the room like black smoke. So sensitive is the light of this lamp to the presence of mercury vapour that the room in which the experiments were conducted had to be ventilated before each experiment, owing to the presence of mercury in the cracks of the floor, for the light of the lamp is reduced to half its intensity by traversing a layer of mercury vapour at room temperature only 5 mm. in thickness. The resonance radiation was observed in a quartz tube with plane-parallel end-plates into which a small drop of mercury had been introduced before being highly exhausted and sealed. Light from a Westinghouse quartz arc was passed through a quartz spectrograph, and light of wave-length 2536 secured by means of a slit in the focal plane of the eye-piece. This monochromatic light was either made parallel, or brought to a focus by a pair of quartz lenses, and the photographs taken of the resonance tube when this light was passed into it at one end showed an image of the cone of rays traversing the high vacuum precisely as if the tube were filled with dense smoke. The tube was at room temperature, and the density of the Hg vapour was about 0·301 mm. Diagrams are given of the various pieces of apparatus used in the rest of the research, and full descriptions are given. Photographs are reproduced illustrating the main points of the paper. The author has discovered a considerable polarisation in the fluorescent light emitted by Na, K, and I vapour, and expected to find it also in the case of the Hg resonance radiation, as the mechanism of the emission would appear to be much simpler in this case than in the other cases, where we have, in addition to the resonance radiation, other associated frequencies emitted, which give rise to what he has named "resonance spectra." No trace of any polarisation could, however, be detected. [See also Abstracts Nos. 1427 (1908), 1529 (1909), 42 (1912), &c.] A. W.

1183. *Reciprocal Action of Neighbouring Fields on a Silver Bromide Plate.* **G. Eberhard.** (Phys. Zeitschr. 13. pp. 288–292, April 1, 1912.)—During experiments on the action of screen-plates upon photographic photometric measurements it is found that with silver bromide plates the blackening of a field on a dryplate is dependent on the blackening of the neighbouring portions of the plate, and the experiments here described form an investigation of this phenomenon. The results in all cases show that the blackening in a neighbouring part of the plate causes that in any particular region to diminish. This is analogous, under known conditions, to the effect of contrast appearances on the human eye. An object in front of a clear background appears darker both to the eye and the photographic plate than when the background is dark. The opinion is expressed that a continuation of these experiments may cause some light to be thrown upon the problem of the physical processes taking place in the film during the development of a silver bromide plate. A. E. G.

1184. *Colour Photography by Prismatic Dispersion.* **J. and E. Rheinberg.** (Photographic Journ. 52. pp. 162–191, April, 1912. Nature, 89. pp. 307–309, May 23, 1912.)—The authors describe apparatus and methods for this process, the principle of which is as follows: (1) The real image is focussed upon an opaque screen with narrow, transparent, parallel lines; (2) This real image is focussed upon the photographic plate by a lens and prism which give for each point of each transparent line a micro-spectrum more or less incomplete according to the local colouration of the object photographed; (3) The development of the photographic negative of these micro-spectra; (4) The production of a black-and-white transparency positive of the same; (5) the use of the positive as a screen in superposition to a series of complete micro-spectra produced by optical means in the camera, which is used as an instrument for viewing the picture. Each complete micro-spectrum is more or less cut off by the screen, and the result is a distribution of colour in the field of view, reproducing the original colours. The history of the idea is referred to, and then follows a detailed discussion of the optical requirements, and as to plates, exposure, &c., adjustments, methods of viewing, and possible further developments. A. D.

1185. *Fogging Power of Developers.* II. *Sulphite Fog and Solubility of Silver Bromide in Sulphite Solutions.* **C. E. K. Mees** and **C. W. Piper.** (Photographic Journ. 52. pp. 221–235; Discussion, pp. 235–237, May, 1912.)—In the former paper it was shown that sodium sulphite, when present in the developer in certain proportions, encouraged the production of fog, and this effect was attributed to the solvent properties of sodium sulphite in respect to silver bromide, the fog being caused by the reduction of silver from the dissolved salt over the plate. The degree of solubility of silver bromide in sodium-sulphite solution is therefore first dealt with in the present experiments. A curve plotted from the results obtained shows that the silver salt taken up into the solution is very nearly proportional to the concentration of the sulphite. The main portion of the curve is nearly straight, but certain important irregularities occur. There is a distinct suggestion of a minimum at the sulphite concentration N/6·7, while when the concentration exceeds N/1, the curve tends to rise sharply. This is in agreement with the observed facts that sulphite fog tends to a minimum at sulphite concentrations of from N/10 to N/5, and increases rapidly with high concentration. The curve also suggests a max. solubility at about N/200, which is very nearly the concentration at which sulphite fog reaches a maximum with hydroquinone and caustic-soda developer. A point of note is that the fog produced at weak concentrations is stained, while that at high concentrations is colourless.

Stain seems to disappear as soon as the sulphite concentration reaches N/20, *i.e.*, about 1 per cent. sulphite is necessary to produce visible stain, though 2½ per cent. is required to insure minimum fog. The only definite fact arrived at from the conductivity measurements is that there is probably chemical combination between the sulphite and the reducing agent, and the appearance of max. fog with low sulphite concentrations can be accounted for if we assume that in the case of hydroquinone the compound has fogging properties which are not possessed by the pyro and sulphite compound. The solubility of silver bromide in water and other solvents is considered, the results obtained being for the most part lower than those obtained by Valenta, and, in the case of ammonium sulphocyanide, of a different order of magnitude. A. E. G.

1186. *Temperature of Sources of Light.* **H. Buisson** and **C. Fabry.** (Comptes Rendus, 154. pp. 1349–1351, May 20, 1912.)—Very diverse opinions exist as to the temperatures of luminous gases, some holding that temperature alone is incapable of producing luminosity in a gas, and others that all radiation is a purely thermal effect. The study of the width of spectrum lines can furnish indications, if not of the cause of radiation, at least of the real temperature of the luminous gas considered. When the pressure of the gas is very small, the effect of impacts between the particles is negligible, and the width of lines is explained completely by the Doppler-Fizeau effect corresponding to the velocities of thermal agitation. As previously shown [see Abstract No. 1190 (1912)] the width of lines diminishes very greatly when the discharge tube is plunged in liquid air. Consequently the radiation cannot be considered as of thermal origin. The authors have applied the same considerations to the study of several other cases. The Cooper-Hewitt mercury lamp [gives lines not so fine as those given by a tube with small current-density. The number of the order of limiting interference is about 400,000. This gives a max. possible temperature of 1200° C. This is probably much too high, for the effect of impacts is by no means negligible in this lamp; hence, again, temperature alone will not account for the radiation. With the arc between iron poles in air at low pressure lines of width 0·03 Å. were found in the region 5300. The effect of impacts being here negligible, a temperature of 2400° C. is deduced. It is possible that at this temperature the radiation may be, in part, of thermal origin. The same arc at atmospheric pressure gives lines of about double the width. The perturbation due to impacts is here considerable, and the temperature cannot be calculated. In the case of flames, making certain assumptions, the theoretical results agree well with those found experimentally. Similar deductions applied to the absorption lines of the solar atmosphere also give good agreement between theory and experiment, except in the case of the H and K lines of Ca, which have a width very much greater than theory would indicate. A. W.

1187. *Resonance Spectrum of Iodine.* **J. Franck.** (Deutsch. Phys. Gesell., Verh. 14. 8. pp. 419–422, April 30, 1912.)—A paper describing experiments showing how the resonance spectrum of iodine vapour is transformed into a band spectrum with admixture of gases. Previous work by Wood, and by Wood and Franck is dealt with [see Abstracts Nos. 341, 469, 470, and 880 (1911)]. Then it is shown that H, N, and O, by admixture with iodine vapour, when excited with monochromatic light to give fluorescence, effect the same transformation of the resonance spectrum into a band spectrum, though not to the same extent, as is the case with the rare gases. With increasing electron affinity this variation of the spectrum is more and more hidden by the apparent reduction of the total emission. Photographs are reproduced. **A. W.**

1188. *Influence of Temperature on the Infra-red Absorption of Gases.* **E[va] v. Bahr.** (Ann. d. Physik, 38. 1. pp. 206–222, May 7, 1912.)—It has been found that the absorption of gases for infra-red radiation depends largely on the pressure [see Abstract No. 1702 (1910)]. In the present paper it is shown that the effect of temperature on the infra-red absorption is quite different from that of pressure. Increase of temperature seems to cause a considerable damping of the absorbing particles; increase of pressure, on the other hand, increases the number of these particles up to a certain limit. The temperature effect was investigated in CO_2, CO, N_2O, CH_4, and ether vapour. The results are tabulated and graphed. From the results it seems probable that the damping of the absorbing particles does not depend on the molecular impacts, but rather on intramolecular conditions; also it appears that the absorption of gases in the infra-red region of the spectrum is of a continuous nature. **A. W.**

1189. *Flame-arc Spectra.* **H. Hertenstein.** (Zeitschr. wiss. Phot. 11. pp. 69–87, April, and pp. 119–132, May, 1912.)—The metals Cu, Pb, Sn, Fe, and Al exhibit well-marked bands in the flame arc, while Cd and Zn give only line spectra. The flame-arc spectra of the compounds $CuCl_2$, $CuBr_2$, CuF_2, $SnCl_4$, $SnBr_4$, SnI_4, $PbCl_2$, $PbBr_2$, PbI_2, $K_2Cr_2O_7$, and AgCl can be divided into two groups. The first group, $CuCl_2$, $CuBr_2$, and CuF_2, show without doubt in the arrangement and structure of the bands the influence of the halogens. The second group includes the rest of the compounds named. The spectra of this group are identical with the flame-arc spectra of the metals, and consist, with the exception of AgCl, of bands. Whether these are due to the oxide or to the metal itself is not decided. In any case the haloid or the Cr_2O_7 group has no influence on their structure. A comparison with the flame spectra of these compounds in the oxygen—coal-gas flame shows coincidence of the flame bands with those of the flame arc. This seems to point to the conclusion that the processes which are going on in the flame arc give rise to the same oscillation conditions as in the flame. Besides the band spectra the most intense arc lines were emitted in the flame arc. With Cu and Ag a weakening of certain lines was observed. In an atmosphere of CO_2 the flame-arc spectra of Cu and Sn are weakened. A continued supply of oxygen caused a strengthening of the spectra of Cu and Pb, but a weakening of the bands in the case of Sn. The flame-arc spectrum does not extend so far into the region of short wave-lengths as that of the arc, though it extends farther than with the blow-pipe flame. From this it is concluded that the temperature in the flame arc is less than that of the arc, and higher than in the blow-pipe flame. Tables are given of all results, many of which are new; and photographs of the different spectra dealt with are reproduced. **A. W.**

1190. *Width of Spectrum Lines, and Interference Fringes with Large Path-difference.* **C. Fabry** and **H. Buisson.** (Comptes Rendus, 154. pp. 1224–1227, May 6, 1912. Journ. de Physique, 2. Ser. 5. pp. 442–464, June, 1912.)—The emission lines of a gas always have a certain width Δ, which, as Schönrock showed, is given by the formula $\Delta = 0{\cdot}82 \times 10^{-6} \times \lambda \sqrt{(T/m)}$, T being the absolute temperature and m the mass of the luminous particles. In general, the width is much too small to show itself with prism or grating spectroscopes, but by interference methods the width of the lines can be measured by investigating the limit up to which interference can be observed. If N is the number of the order corresponding to the limit of visibility of the fringes, then $\Delta = \lambda/N$, and consequently $N = 1{\cdot}22 \times 10^6 \sqrt{(m/T)}$...(i). This result only holds good for small pressures, where the impacts of the particles are relatively infrequent. If the mean free path of the particles is not notably larger than the wave-length, the impacts produce a widening Δ_1 which is given by $\Delta_1/\Delta = 0{\cdot}6\,\lambda/L$, where L is the mean free path. In Geissler tubes, where the pressure is of the order of 1 mm. of mercury, L is of the order 100 μ, and the ratio λ/L is very small. The effect of impacts is consequently negligible. The formula (i) above has been experimentally verified by Michelson for the rays emitted by metallic vapours at low pressures and at comparatively low temperatures. For example, in the case of Hg, making $m = 200$ and $T = 400°$, the formula gives $N = 860{,}000$; experiment gives 770,000. The authors have studied the rare gases of the atmosphere, with the double object of verifying the theory and of perfecting sources of monochromatic light. To measure the width of the different lines, interference fringes were produced using two silvered surfaces, plane and parallel, whose distance apart could be increased to several decimetres. The order of interference was obtained by dividing double the distance between the surfaces by the wave-length. This distance was increased till the fringes ceased to be visible, and thus the limit N of the order of interference was obtained. Tubes of He, Ne, and Kr were used with alternating current. In the first series of experiments the tubes were placed in a bath of water at the temperature of the laboratory. The following numbers were obtained for N: He 144,000 ($\lambda = 5876$), Ne 324,000 ($\lambda = 5852$), Kr 600,000 ($\lambda = 5570$). The formula gives, for the same limits, the values 144,000, 321,000, and 597,000. Theory indicates that the lines should be finer as the temperature is lowered. This was verified by experiments with the tubes in liquid air. The effect on the width was very marked; when, with the tube at the ordinary temperature, the limit of interference had been reached, cooling the tube in liquid air caused the fringes to reappear brilliantly. The new interference limits were then for the three gases 241,000, 515,000, and 950,000. According to theory, the limits of interference in the case of a gas at two different temperatures ought to be as the square root of the inverse ratio of the absolute temperatures. For the two series of experiments, where the temperatures were about 300° and 100°, the ratio should be 1·73. The experimental ratios are 1·66, 1·60, and 1·58. A slight excess of the gas temperature over that of the bath explains the small difference between the theoretical number and the experimental results. The results generally confirm the principles of the kinetic theory of gases, and tend to the conclusion that the mass of the luminous particles is of the same order of magnitude as that of the atoms, and that the temperature of the luminous gas is little different from that of the surrounding medium. The luminosity of the gas can therefore not be attributed to a high temperature. The order of interference 950,000 which is obtained with the Kr line $\lambda 5570$ at the temperature of liquid air corresponds to a path-difference of 53 cm. This is the greatest path-difference hitherto observed with light-waves. The width of the line is only 0·006 Å. Tubes containing the rare gases thus may furnish very convenient sources of remarkably monochromatic light. A. W.

1191. *Doppler-effect of Hydrogen Canal Rays.* **E. Wagner.** (Phys. Zeitschr. 13. pp. 257–260, April 1, 1912.)—Describes an investigation of the variation of the Doppler-effect of hydrogen canal rays along their path. The vacuum tube employed had a spherical discharge space, and the observation tube behind the kathode gave a path of 55 cm. for the canal rays. These were observed at an angle of 45° with the path of the rays through short side-tubes closed with plane glass plates. At small pressures of about 0·05 mm. of Hg the Doppler-effect at the second window from the kathode was found to be greater than at the first, and this increase of the effect along the path of the rays was more marked at a higher pressure of 0·12 mm. At still higher pressures of about 0·24 mm. of Hg, when the luminous effect of the canal rays only just reached to the second window, the Doppler-effect at this window was considerably smaller than at the first. Possibly some explanation of the results is given by Strasser's observations [Abstract No. 905 (1910)] on the effect on the appearance of the Doppler-effect due to the disintegration of the electrodes, metallic particles thus present in the gas having a similar effect to that of admixed gases. This was tested by observation through the windows in a direction inclined to the first at 90°, and still at 45° to the path of the rays. This removed the observation place farther from the kathode in each case. In no case now was an increase of the Doppler-effect along the path of the rays observed. For the smallest pressures the effect was found to be the same at both windows. At higher pressures it was smaller at the second window; and at the max. pressure permissible (about 0·28 mm.) the displaced line merged into the stationary line. The extinction at the end of their path of the light emitted by the canal rays appears from this research to be due not only to absorption of the moving particles (lessening their number), but also to a marked decrease of their velocity brought about by their impacts with the stationary gas molecules. A. W.

1192. *Displacement of Mean Component of Normal Zeeman Triplets in Helium Spectrum.* **J[ane] Molyneux.** (Phys. Zeitschr. 13. pp. 259–260, April 1, 1912.)—Observations were made with Perot-Fabry plates, and the method was tested first on the yellow Hg line λ5790·6. With this line the results showed almost exact proportionality between the square of the field strength and the displacement of the mean-component. Measurements are given on six He lines, and from the formula $e/m = 2\pi c^2 \delta b/\mathrm{DH}$ the mean value of e/m is deduced. The result obtained is $5{\cdot}655 \times 10^{17}$. D is the thickness of the air plate, H the field strength, and δb the displacement of the line in question.

A. W.

1193. *Zeeman-effect.* **A. Cotton.** (Astrophys. Journ. 35. pp. 218–220, April, 1912.)—Purvis has pointed out [see Abstract No. 148 (1912)] that the absolute values of the Zeeman-effect for four Cr lines given by himself and by Miller, Hartmann, and by Babcock, are not at all in agreement. The present paper shows that this disagreement arises chiefly from the measurement of the magnetic fields used, and calls attention to the precautions which must be taken in order to render the measurements made in different laboratories comparable with one another. Miller and others have calculated the values of their fields from the results of Runge and Paschen on the magnetic separation of lines. But Runge and Paschen only estimated provisionally at 23,850 units the field they used for the study of the Hg lines, basing their estimate on Färber's work on the blue lines of Zn. Absolute measurements by Weiss and Cotton and by Gmelin show that the field used by Runge and Paschen was in reality very near 23,000, Gmelin's measurements giving 23,010 and those of Weiss and Cotton 23,060. Making this correction for Miller's results they approach those of Babcock. This correction only accentuates the difference between the results of Purvis and Miller, but reasons are given, based on other results of Purvis, which show that the field used by him is not 39,980 as given, but near 30,000. Comparison of Hartmann's figures with others obtained by Mme. Graftdijk for Ni, leads to the conclusion that the magnetic fields given by him are a little too large. It is suggested that magnetic field measurements should be made by utilising the measurements on the Zn lines, for which the absolute measurements have furnished practically identical results. Various precautions are noted. A. W.

1194. *Magnetic Spectrum of the β-Rays of Thorium.* **O. v. Baeyer, O. Hahn, and L. Meitner.** (Phys. Zeitschr. 13. pp. 264–266, April 1, 1912.)—A continuation of work on the β-radiation of various radio-active bodies [see Abstracts Nos. 1710 (1910), 1137 (1911), 319 (1912)]. It has previously been shown that the β-rays, as well as the α-rays, leave the radio-active atom with characteristic velocities. The results have now been extended to thorium, Meitner's method of separation of the various decay products being used [Abstract No. 245 (1912)]. The following table shows the velocities of the β-rays from the different Th-products, the velocities being expressed as fractions of the velocity of light:—

*MesoTh*2.—Rapid β-rays, velocity over 0·7 that of light, together with $\beta = 0{\cdot}66$, 0·60 (weak); 0·57, 0·50, 0·43, 0·39, 0·37 (strong).

ThX.—$\beta = 0{\cdot}51$ (weak); 0·47 (strong).

ThA.—$\beta = 0{\cdot}72$ (weak); 0·63 (very strong).

Th $(B + C + D)$.—Rapid β-rays, velocity over 0·72 that of light, together with $\beta = 0{\cdot}36$ (weak); 0·29 (strong). A. W.

1195. *Fluorescence of Iodine Vapour excited by Polarised Light.* **J. Franck and G. Hertz.** (Deutsch. Phys. Gesell., Verh. 14. 8. pp. 423–425, April 30, 1912.)—Light from a large arc lamp with horizontal carbons was focussed by means of a condenser on a small diaphragm placed at the focus of a lens which gave parallel light through a Nicol prism with perpendicular ends. The polarised light thus obtained was sent along the axis of a dumb-bell shaped tube containing iodine vapour at a pressure of about 0·2 mm. Above and below the middle of this tube were two parallel mirrors which sent the fluorescent light from the tube in two directions, perpendicular to one another, to the two sides of a Lummer-Brodhun photometer. If the plane of polarisation of the exciting light was parallel or perpendicular to the mirrors, the figure in the photometer disappeared. With the nicol turned through an angle of 45° it was shown that the intensity of the fluorescent light was a maximum in the plane of polarisation of the exciting light. The same result was obtained using sunlight for excitation. It was also found that the intensity perpendicular to the plane of polarisation of the exciting light was about 16 per cent. smaller than that in the plane of polarisation. [See also Abstract No. 469 (1911).] A. W.

1196. *Theory of the Dissymmetrically-distributed Röntgen Radiation.* **J. A. Crowther.** (Cambridge Phil. Soc., Proc. 16. No. 6. pp. 534–539, April 22, 1912.)—When Röntgen radiation falls upon a radiator, it causes it to emit kathode rays in considerable quantity. Some of these escape from the surface of the radiator, but in most cases the bulk of the rays are stopped within the radiator itself. On almost any theory of Röntgen radiation the stoppage of these particles must give rise to a further production of Röntgen rays. In the course of some experiments [Abstract No. 477 (1911)] on the distribution of the secondary Röntgen radiation, it was found that the scattered radiation was not distributed symmetrically round the radiator as was to be expected from theory, but that there was always an excess of radiation in the forward or emergence direction as compared with that in the reverse direction. The fact that the return radiation followed very closely the distribution assigned it by theory suggested that this excess forward radiation might be due to some other source than the pure scattering of the primary beam. In the present paper the question is considered as to the possibility of the excess radiation being due to the stoppage of the kathode particles in the radiator, alluded to above. The examination shows that the experimental evidence so far available is not unfavourable to this assumption which is shown to be capable of explaining all the known properties of the excess forward radiation. E. M.

1197. *Passage of Homogeneous Röntgen Rays Through Gases.* **E. A. Owen.** (Roy. Soc., Proc. Ser. A. 86. pp. 426–439, May 8, 1912.)—In experiments on the relative ionisation in gases by Röntgen rays, not only rays of exactly the same hardness and the same intensity should be used to ionise each gas, but in order to obtain quite definite results it is necessary to use rays of quite a distinct hardness. In these experiments homogeneous characteristic rays from various metals were used, and in order to obtain narrow pencils of the required intensity, a specially-designed Röntgen-ray bulb was used in which a window served as antikathode, the primary rays falling on metal radiators placed near the window. The results show: (1) The absorption of homogeneous radiation in a gas is proportional to the pressure. (2) The absorption of the different homogeneous radiations in CO_2 and SO_2 is proportional to the absorption of those radiations in air. (3) For the homogeneous rays emitted by metals of atomic weight ranging from that of Fe to that of Mo, the coefficient absorption in the gases investigated is approximately inversely proportional to the fifth power of the atomic weight of the radiator which emits that characteristic radiation. (4) The ionisation relative to air is approximately constant in the same gas for the different homogeneous rays. (5) The total number of ions produced by homogeneous beams of equal intensity is approximately the same in each gas for any particular type of rays. In all the above experiments the corpuscular radiation emitted by the walls of the ionisation chambers was either eliminated or corrected for. E. M.

1198. *Structure of γ-Rays.* II. **E. Meyer.** (Ann. d. Physik, 37. 4. pp. 700–720, March 26, 1912.)—The author has shown in a previous paper [Abstract No. 81 (1911)] that γ-rays show Schweidlerian fluctuations not only with time but also in the actual number of pairs of ions they produce. From this it was deduced that the energy of a single γ-ray does not spread uniformly in an expanding sphere, but that it travels concentrated in certain directions only. Campbell, however [Abstract No. 694 (1912)], argues that if γ-rays do not directly ionise (a necessary conclusion of Bragg's theory of γ-rays), the author's experiments are not sufficient in themselves to allow conclusions regarding isotropic or anisotropic structure of γ-rays. Further experiments are described in the present paper and the following conclusions are drawn:—(1) A small part of the variations in the ionisation by γ-rays depends on the nature of the material of which the ionisation chamber is composed, but the chief part is quite independent of it. (2) A single γ-ray can produce ionisation in two different ionisation chambers. This may occur not only when the chambers lie one behind the other along the direction in which the γ-ray is propagated, but also under conditions when they are transverse to this direction. Thus, one γ-ray can either ionise more than once or produce more than one β-ray. In the former case the results indicate that one γ-ray can ionise at various points of its path without losing all its energy. These results are inconsistent with the theories of both Bragg and Stark. They agree, however, with Sommerfeld's theory in that they show that a γ-ray is only partially anisotropic. E. M.

1199. *Number and Ranges of α-Particles emitted by the Emanation and Active Deposit of Thorium.* **T. Barratt.** (Phys. Soc., Proc. 24. pp. 112–119, Feb., 1912. Le Radium, 9. pp. 81–84, March, 1912.)—Experiments by Bronson [see Abstract No. 1799 (1908)] and by Geiger and Marsden have shown that the total number of α-particles from ThEm and Th active deposit in equilibrium is about three times the number from the active deposit alone, or the number from ThEm is twice as many as from the active deposit in equilibrium with it. Those experiments all refer to the whole active deposit; no results have been published up to the present which give a relation between the number of α-particles from all the products and those from a single product of the series. The present experiments therefore aim at an exact determination of (1) the relative number of α-particles from each of the four products ThEm, ThA, ThC_1, and ThC_2; (2) the ranges of the α-particles from the same four products. By the methods described it is found that—

ThEm	emits	100	particles of	5·0	cm. range	
ThA	„	100	„	5·4	„	
ThC_1	„	85	„	4·8	„	
ThC_2	„	65	„	8·6	„	

A. E. G.

1200. *Absorption of γ-Rays by Gases and Light Substances.* **J. Chadwick.** (Phys. Soc., Proc. 24. pp. 152–156; Discussion, pp. 156–157, April, 1912.)—The absorption coefficients of air, CO_2, and hydrogen for the γ-rays from radium, have been measured after the rays have traversed 8 mm. and 1 cm. of lead. The gases were contained in an iron cylinder and were under considerable pressure. The values found for the absorption coefficients are, at normal temperature and pressure, $6·2 \times 10^{-5}$, $10·2 \times 10^{-5}$, and $0·42 \times 10^{-5}$ $(cm.)^{-1}$ for air, CO_2, and hydrogen respectively; the thickness being 8 mm. When the thickness of lead is 1 cm. the absorption coefficients are $5·9 \times 10^{-5}$, $9·2 \times 10^{-5}$ cm. for air and CO_2 respectively. The absorption coefficient of air was also determined by using liquid air. The absorption coefficients found in this way are in good agreement with the values found for air under pressure, showing that the absorption of γ-rays is not affected by temperature. The absorption coefficients of a number of light substances and solutions were also found. E. M.

1201. *Balance Method for Comparison of Quantities of Radium.* **E. Rutherford** and **J. Chadwick.** (Phys. Soc., Proc. 24. pp. 141–151; Discussion, pp. 156–157, April, 1912. Le Radium, 9. pp. 195–200, May, 1912.)—The authors first discuss the application of the γ-ray method to the comparison of quantities of radium, the influence of the γ-rays of RaB [Abstract No. 860 (1912)] and the γ-rays due to mesothorium impurity being considered. A balance method is described for accurately comparing quantities of radium by their γ-radiation, in which the ionisation due to the γ-rays is balanced against the constant α-radiation due to uranium oxide. By observing the distance of the radium preparation from the ionisation chamber when a balance is obtained, the relative γ-ray activities of two preparations can be determined with an accuracy of at least 1 in 400. A method of calibration is given, and the corrections necessary to deduce the quantities of radium present are considered. It is shown that with decaying radium emanation the amount of RaC is always 0·89 per cent. greater than corresponds to permanent equilibrium. The balance method was employed to determine the period of RaEm and the value found was 3·854 days. It was found experimentally that the γ-ray activity due to RaEm and its products reaches a maximum 255 min. after the introduction of the emanation into a sealed tube. Calculations showed that under the experimental conditions the theoretical maximum should also be reached after 255 min. It was found that the γ-ray activity of a radium preparation was not appreciably altered by exposure in a strong magnetic field. E. M.

1202. *Radium Standards.* **H. Mache and St. Meyer.** (Phys. Zeitschr. 13. pp. 320–322, April 15, 1912.)—In view of the recent establishment of an international standard of radium the authors have collected data of the ionisation currents produced under certain conditions by 1 curie of radium emanation. The conditions are such that (1) all the α-particles of 1 curie RaEm and one-half of those of the RaA and RaC associated with it ionise throughout their entire range, and (2) all the α-particles of 1 curie RaEm similarly ionise. The values of these currents calculated from the data of Rutherford and Geiger are $6·10 \times 10^6$ and $2·75 \times 10^6$ e.s. units respectively. The experimental values of Duane and Laborde are 6·81 and $2·49 \times 10^6$ and of Flamm and Mache 6·02 and $2·67 \times 10^6$ e.s. units respectively. E. M.

1203. *Radio-activity.* **H. Thirring.** (Phys. Zeitschr. 13. pp. 266–268, April 1, 1912.)—A mathematical treatment of the effect of absorption in the interior of radio-active matter on the rays emitted. The problem dealt with is the following: Given a sphere of radius a of homogeneous radio-active matter, and assuming the absorption in the interior to be given by the law $i = i_0 e^{-\mu x}$, where i is the emergent and i_0 the incident intensity of the radiation passing through a layer of thickness x, what is the ratio v between the actual quantity of radiation emitted and that which would be emitted supposing no absorption to take place? The results obtained are given below; a' is the radius of a sphere of absorbing but not radio-active material from which would issue the same amount of radiation as with the sphere of radius a, the whole quantity of radio-active material being imagined as contracted to a point source of radiation at the centre.

a.	a'.	v.
2 cm.	1·465 cm.	0·9375
1 „	0·732 „	0·9683
0·5 „	0·366 „	0·9840
0·1 „	0·073 „	0·9968

The value of μ is taken as 0·044. A. W.

1204. *Radio-activity.* **E. v. Schweidler.** (Phys. Zeitschr. 13. pp. 453–454, May 15, 1912.)—A paper dealing with the same problem as is discussed by Thirring [see preceding Abstract]. The mathematical treatment is different, but the results obtained are in fair agreement. Taking $\mu = 0{\cdot}044$, we have—

μ.	v.	
	Thirring.	v. Schweidler.
2 cm.	0·9875	0·98699
0·1 cm.	0·9968	0·99671

A. W.

1205. *Negative Result connected with Radio-activity.* **J. H. Vincent** and **A. Bursill.** (Phys. Soc., Proc. 24. pp. 71–74, Feb., 1912.)—Specimens of iron, antimony, and bismuth were subjected to a high-frequency alternating magnetic field. The air in the neighbourhood was tested for any ionisation that might have been thus produced. The results were negative. E. M.

1206. *Secondary Rays excited by α-Rays from Polonium.* **V. E. Pound.** (Phil. Mag. 23. pp. 813–837, May, 1912.)—It is known that when α-rays fall on any material, negatively-charged particles, or δ-rays, are emitted. The author shows that this secondary radiation is in part due to the presence of gas occluded in or at the surface of the materials examined in the paper: brass and carbon. When this gas is being removed from the brass or carbon it is found that the secondary radiation decreases and gives rise to an effect similar to a "fatigue." E. M.

1207. *Decay Constant of Polonium.* **E. v. Schweidler.** (Deutsch. Phys. Gesell., Verh. 14. 10. pp. 536–539, May 30, 1912.)—The author finds the period of polonium to be 136·5 ± 0·3 days, in good agreement with Regener's value 136·0 ± 0·5 days [Abstract No. 827 (1912)]. E. M.

1208. *New Radiation from Polonium.* **H. A. Bumstead** and **A. G. McGougan.** (Phys. Rev. 34. pp. 234–235, March, 1912. Abstract of paper read before the Amer. Physical Soc., March, 1912.)—In continuation of the work by Bumstead [Abstract No. 198 (1912)] on the emission of secondary δ-rays by α-rays the authors have noted a hitherto unrecognised radiation from polonium. The radiation is stopped by $0{\cdot}7 \times 10^{-4}$ cm. of Al, and appears to consist of electrons projected from the Po with various velocities corresponding to a fall of potential of from 160 to 500 volts. This is much faster than δ-rays and much slower than ordinary β-rays. Whether the radiation comes from the Po itself or from some other radio-active substance associated with it may be determined later by its decay. Evidence was also obtained of the emission of recoil atoms from the polonium. E. M.

1209. *Penetrating Radiation present in the Atmosphere.* **A. Gockel.** (Jahrbuch d. Radioakt. 9. pp. 1–15, April, 1912.)—A concise account of all the recent work on the measurement of the penetrating radiation in the atmosphere is given and the results are discussed. The author has examined over a number of years the daily and yearly periods of the radiation and its dependence on meteorological conditions and on the nature of the locality in which the observations have been carried out. A large chamber of zinc, of 20 litres' capacity, connected to a Wulf electrometer was used as measuring apparatus. No very precise rules connecting the radiation with the various conditions have been arrived at owing to the complexity of the phenomenon. The radiation appears to come from radio-active products present in the first metre of the earth's crust only, and is absorbed to a large extent by thicknesses of ice or water. The penetrating radiation from a glacier was only one-tenth of that in a tunnel through some rocks containing quartz. Atmospheric pressure, wind direction, and clouds do not influence the amount of the penetrating radiation although the amount of emanation in the air depends very considerably on these conditions. The radiation appears to undergo a daily period, but it is difficult to say whether there is a yearly period. E. M.

1210. *Radio-activity of Water issuing from Monte Amiata, and Atmospheric Dispersion in the Neighbourhood.* **R. Nasini** and **C. Porlezza.** (Accad. Lincei, Atti, 21. pp. 816–824, March 8, 1912.)—Examination of the water from 39 different springs on Mt. Amiata shows that, with three exceptions, all the waters have marked radio-activity, the quantity of emanation found in 1 litre varying from 0·26 mm.^{3} × 10^{-10}, up to 25·48 mm.^{3} × 10^{-10}, with an average of 9·6 mm.^{3} × 10^{-10}. Of nine samples of the surrounding soil five were active, the dispersion in volt-hours ranging from 5·3 to 45, and the atmospheric dispersion in the neighbourhood varies from 0·192 to 0·782 volt-minutes. W. H. Si.

1211. *Quantities of Radium and Thorium Emanations contained in Certain Soils.* **J. Satterly.** (Cambridge Phil. Soc., Proc. 16. No. 6. pp. 514–538, April 22, 1912.)—In a previous paper the author described some experiments made to measure the amount of RaEm in the air of soils [see Abstract No. 722 (1912)]. The air is abstracted by means of an aspirator through a narrow pipe let down into the soil. When sufficient air has been collected it is passed into a testing vessel and the RaEm estimated from the leak produced. The experiments have now been carried on for a whole year. The results show that for depths of 100–150 cm. in gravelly soil the amount is, on the average, about 200 × 10^{-12} curie per litre, or 2000 times as much as there is usually in the atmospheric air. Experiments showed that a litre of soil air was in association with 12,000 gm. of dry soil, whence the apparent Ra-content of the soil is 1·7 × 10^{-14} gm. per gm. As the actual Ra-content is about 70 times this, it follows that little of the emanation generated in the solid particles of the soil can escape under normal conditions into the air around them. The proportion of RaEm to ThEm in soil air was measured for various depths, and the ratio was found to increase from 1600 near the surface to 26,000 at a depth of 400 cm. At a depth of 150 cm. it was 8600, whence the Th-content works out as 1·4 × 10^{-5} gm. per gm. E. M.

1212. *Michelson's Experiment.* **M. Laue.** (Phys. Zeitschr. 13. pp. 501–506, June 1, 1912.)—Discusses the three objections raised by E. Budde (Phys. Zeitschr. 12. p. 979, 1911) to the experiment of Michelson. E. H. B.

1213. *Theory of Trouton and Noble's Experiment.* **M. Laue.** (Ann. d. Physik, 38. 2. pp. 370–384, May 23, 1912.)—A mathematical discussion of the theory of the above experiment on the relativity principle. [See Abstract No. 1994 (1904).] E. H. B.

1214. *Abnormal Electric Dispersion.* **H. Merczyng.** (Acad. Sci. Cracovie, Bull. 4a. pp. 298–308, April, 1912.)—A discussion, largely mathematical, of Drude's theory of abnormal electric dispersion. [See Abstract No. 794 (1898).] E. H. B.

1215. *Spectroscopic Laboratory of the Imperial College of Science and Technology, London.* **A. Fowler.** (Phys. Soc., Proc. 24. pp. 168–171, April, 1912.)—Descriptive.

1216. *Intensity at Points near the Principal Focus of an Object-glass with Symmetrical Aberration.* **J. Walker.** (Phys. Soc., Proc. 24. pp. 160–165; Discussion, p. 165, April, 1912.)—The author obtains a convenient expression for the intensity by a modification of Stuhl's method (Theorie des Fernrohrs, Leipzig, 1894). L. H. W.

1217. *Representation of a Transparent Grating.* **M. Wolfke.** (Ann. d. Physik, 38. 2. pp. 385–396, May 28, 1912.)—A theoretical consideration.

1218. *Direct Measurement of Phase-difference in Interferometer.* **G. Sagnac.** (Comptes Rendus, 154. pp. 1346–1349, May 20, 1912.)—A description of the author's interferometer with inverse beams of light superposed has previously been given [Abstracts Nos. 1106 and 1418 (1910)]. In the present paper a method is described of measuring directly the phase-difference of the two interfering beams by slightly turning the system of two prisms and measuring the shift of the central fringe. A. W.

1219. *Wave-lengths of Iron Spectrum.* **H. Buisson** and **C. Fabry.** (Ann. d. Physik, 38. 1. pp. 245–246, May 7, 1912.)—Comparison of small differences between normal lines adopted for determination of standard wave-lengths of the iron arc spectrum. [See Abstract No. 492 (1912).] C. P. B.

1220. *Structure of Spectrum Bands.* **R. Fortrat.** (Comptes Rendus, 154. pp. 1153–1156, April 29, 1912.)—The series formulæ representing the structure of several fluted spectra are discussed, and the importance of certain divergences which have been noticed is emphasised. A graphical method of showing the relation of the doublets is also given. C. P. B.

1221. *Fluctuations in Ionisation by γ-Rays.* **T. H. Laby** and **P. W. Burbidge.** (Roy. Soc., Proc. Ser. A. 86. pp. 333–348, April 25, 1912.)—The paper gives a more complete account of the experiments described in Abstract No. 1850 (1911) and also gives details of the string electrometer. E. M.

1222. *Radio-activity of Mineral Springs at Arima (Japan).* **D. Isitani** and **K. Manabe.** (Mathematico-Physical Soc., Tōkyō, Proc. 6. 15. pp. 220–229, April, 1912.)—The paper deals with experiments in continuation of those described in Abstract No. 708 (1912). A hot spring was investigated whose waters contained 18,800 curies $\times 10^{-13}$ radium emanation per litre. E. M.

HEAT.

1223. *Adiabatic Device for a Bomb Calorimeter.* **J. A. Fries.** (Amer. Chem. Soc., Journ. 84. pp. 648–652, May, 1912.)—The value of an adiabatic equipment to a bomb calorimeter lies in the fact that such a device may be a means both of saving time and of greater accuracy in determining the heat of combustion. It does away with much tedious computation, and the correct temperature of the calorimeter before and after a combustion is more readily obtained. Adiabatic devices differing in principle have been described by Richards, Henderson and Trevert, and Benedict and Higgins, but since these are not made so as to be easily adjusted to bomb calorimeters that are already installed and in use, a simpler device was sought for to fill that want. The problem was satisfactorily solved by applying to the bomb calorimeter, the same principle which is used in the respiration calorimeter according to Atwater and Rosa. Any bomb calorimeter of the Atwater-Berthelot type, can be made adiabatic without much expense by a simple device. The materials used in the construction of the apparatus were such as could be picked up in any laboratory. The heating device consisted of a German-silver wire about 8·5 m. long and 0·8 mm. in diam., having a total resistance of about 6·1 ohms. This wire was strung through small brass eyelets, screwed directly into the inner insulating fibre jacket of the modified Atwater-Berthelot bomb. Mercury thermometers were found useless for measuring the air temperature, and electric thermometers being difficult and costly to instal, it was finally decided to use an air thermometer. Besides securing a quick registration of the resulting rise in temperature, it was also necessary to provide some way to regulate the heating effect upon the calorimeter and make it uniform. This is effected by placing the calorimeter inside a double-walled copper jacket which constituted the bulb of the air thermometer. Details of the method of use and the advantages to be obtained from this addition to the usual form of bomb calorimeter are finally given. J. B. C. K.

1224. *New Methods used in Linear Expansivity.* **A. W. Gray.** (Washington Acad. Sci., Journ. 2. pp. 248–258, May 19, 1912.)—Suppose it is required to find the expansion of a solid between two places enclosed in some apparatus. Fine silver wires are attached to the places, and these are weighted to keep them straight. The distance between these parallel wires can be measured by microscopes. The special problem to which the above method is applied is to find the expansion between 0° and 1800° C. of steel rods, 80 cm. long, heated electrically, and carefully lagged to maintain the temperature very constant. The writer works out in detail what devices are desirable for obtaining steady internal temperatures when these are high. P. E. S.

1225. *Anisotropic Expansion of Quartz-glass.* **H. L. Callendar.** (Zeitschr. Instrumentenk. 82. pp. 194–195, June, 1912. From the English.)—As a practical reply to Scheel's criticism on Harlow's experiments on the expansion of quartz-glass, Callendar tests the expansion of two pieces of this material taken from the same tube. One piece is mounted so as to have its axis vertical, and it supports an optically-true glass slab: the other piece lies within the first, but has its axis horizontal. The top of the latter being flat and optically true, it forms fringes with the glass slab. Thus by Fizeau's method the relative axial and radial expansion of the tube is obtained. The absolute axial expansion is also obtainable by this plan. It is found that between 0° and 100° the axial coefficient is $0{\cdot}2 \times 10^{-6}$ c.g.s. greater than the radial; whilst the axial coefficient is $0{\cdot}46 \times 10^{-6}$. This gives the mean cubical coefficient for the tube when used as a weight thermometer as $0{\cdot}98 \times 10^{-6}$ c.g.s., which agrees with the result found by Harlow using the coefficient of mercury given by the research of Callendar and Moss. Again, the difference between the radial and axial coefficient increases, but the axial coefficient decreases, as temperature falls; so the cubical coefficient in the neighbourhood of 0° vanishes. P. E. S.

1226. *Melting-points of Tungsten and Molybdenum.* **M. v. Pirani** and **A. R. Meyer.** (Deutsch. Phys. Gesell., Verh. 14. 8. pp. 426–428, April 80, 1912.)—With the methods previously described [Abstract No. 1168 (1911)] the authors find the melting-point of tungsten 8005° C. (black temperature) or 8100° C.; in the latter case a tungsten wire was brought to fusion in the arc of a mercury lamp, and the temperature observed at which the bead adhering to the bottom of the wire (1 mm. diam.) was seen to be deflected upwards by the pressure of the mercury-vapour jet. Molybdenum gave the melting-point 2450° C. These values are based upon the value of the c_2 constant 14,200 (Holborn and Valentiner). H. B.

1227. *The Combustion of Carbon.* **T. F. E. Rhead** and **R. V. Wheeler.** (Chem. Soc., Journ. 101. pp. 846–856, May, 1912.)—It is often assumed that the first reaction is (*a*) $C + O_2 = CO_2$, and that by contact of the CO_2 with incandescent carbon CO is formed according to (*b*) $CO_2 + C = 2CO$. According to H. Dixon and H. B. Baker, however, the first reaction is (*c*) $2C + O_2 = 2CO_2$, at any rate for the burning of gaseous carbon (explosion of cyanogen), and secondarily (*d*) $2CO + O = 2CO_2$. Using the apparatus constructed for studying the reduction of CO_2, the authors heat carbon (2·5 gm.) in a porcelain tube within an electric furnace while passing a current of oxygen or air over the carbon. The experiments show that at all temperatures both CO and CO_2 are simultaneously formed; at low temperatures some CO appeared, which could not have resulted from (*b*), while CO_2 was also observed in quantities which do not support (*d*). The rate of oxidation (disappearance of oxygen) was the same in air and in oxygen, which is against local heating. Experiments with mixtures of oxygen and CO do not permit of drawing any definite conclusions. H. B.

1228. *Condensation of Water Vapour by Rapid Expansion.* **A. B. Chauveau.** (Le Radium, 9. pp. 85–91, March, and pp. 161–169, April, 1912.)—From a study of previous work on the subject, which the author summarises, it is concluded that the larger ions or "liquid particles" of Langevin, play an important part in the condensation, their condensing action being independent of their charge, and depending only on their dimensions. Such particles have a diam. of about 0·01 μ, and the amount of water present would be about 6×10^{-5} mgm. per m.^{3}. The condensing power of the small ions is open to considerable doubt, and though these have been suggested as responsible for the electric charge of rain, other more likely hypotheses, such as that of Simpson [Abstract No. 1078 (1909)] have been proposed to explain the phenomenon. W. H. Si.

1229. *Radiation Constant.* **W. Gerlach.** (Ann. d. Physik, 38. 1. pp. 1–29, May 7, 1912.)—Describes the absolute determination of the constant σ in the Stefan-Boltzmann radiation law $S = \sigma (t + 273)^4$. The characteristic figures for σ were found to be 5·32 by F. Kurlbaum; C. Féry obtained a value 18·4 per cent. higher, and the mean of a number of other determinations is 6·30. The present paper describes a determination using the thermopile arranged as recommended by F. Paschen. The value obtained is—

$$\sigma = (5{\cdot}803 \pm 0{\cdot}057) \times 10^{-12} \text{ watt cm.}^{-2} \text{ degrees}^{-4}$$
$$= 1{\cdot}386 \text{ cal. cm}^{-2} \text{ degrees}^{-4}.$$

[See Abstracts Nos. 2005 (1900), 1572 (1909), and next Abstract.] E. H. B.

1230. *Absolute Measure of Radiation.* **F. Paschen.** (Ann. d. Physik, 38. 1. pp. 30–42, May 7, 1912.)—Discusses the various methods of measuring absolutely a radiation intensity, and so of finding the value of the radiation constant σ. The result obtained by W. Gerlach, using Paschen's thermopile, is also discussed and found in harmony with other theoretical values. [See Abstracts Nos. 2087 (1909) and preceding Abstract.] E. H. B.

1231. *Radiation Constant.* **F. Kurlbaum.** (Deutsch. Phys. Gesell., Verh. 14. 11. pp. 576–580, June, 15, 1912.)—Discusses the recent work on the determination of the constant σ in the Stefan-Boltzmann law. The author feels that 2·5 per cent. should be added to his value, and also to that of Valentiner. He then gives the following as the recent determinations by various experimenters :—

Authorities.	Dates.	Values of $\sigma . 10^{12}$.
Kurlbaum	1898	5·32 + 2½ per cent. = 5·45
Féry	1909	6·30
Bauer and Moulin	1909	5·30
Valentiner	1910	5·36 + 2½ per cent.
Féry and Drecq	1911	6·51
Shakespear	1912	5·67
Gerlach	1912	5·803

[See also preceding Abstract.] E. H. B.

1232. *Production of Condensation Nuclei in Air by Intense Cooling.* **C. Ramsauer.** (Phil. Mag. 23. pp. 849–852, May, 1912.)—Criticises the results and conclusions of G. Owen. [See Abstract No. 181 (1912).]

1233. *Planck's Radiation Formula.* **P. Frank.** (Phys. Zeitschr. 13. pp. 506–507, June 1, 1912.)—Discusses the derivation by various modes of the radiation formula of Planck. [See Abstracts Nos. 439 (1907) and 345 (1912).] E. H. B.

1234. *Temperatures for Various Values of the Constant c_2 in Wien's Law.* **M. v. Pirani** and **A. R. Meyer.** (Deutsch Phys. Gesell., Verh. 14. 8. pp. 429–430, April 30, 1912.)—Concerned with the various temperatures corresponding with each other on the assumption of different values for the constant c_2 in Wien's law. The note concludes with a conversion table for the temperatures from 1100 to 4000° C., and for values of $c_2 = 14{,}200$, 14,500, and 14,600. E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1235. *Molecular Theory of the Piëzoelectricity of Tourmaline.* **E. Riecke.** (Gesell. Wiss. Göttingen, Nachr., Math.-phys. Klasse, 2. pp. 253–266, 1912. Phys. Zeitschr. 13. pp. 409–415, May 15, 1912.)—As a result of a theoretical investigation, for details of which the original pages must be consulted, the author arrives at the conclusion that the strength of the pole lying on the main axis of the molecule is only a small multiple of the electrical elementary quantum. The polar electric charge ($\epsilon = 8{\cdot}62 \times 10^{-10}$), which is ascribed to the molecules, of tourmaline, is hence of the same order of magnitude as in the case of the molecules of an electrolyte. L. H. W.

1236. *Determination of Capacity of Gold-leaf Electroscopes.* **K. Lichtenecker.** (Phys. Zeitschr. 13. pp. 516–518, June 1, 1912.)—It is shown that the capacity, ρ, of an electroscope may be determined by means of two spheres of different radii, r_1 r_2, by means of the formula $\rho = (r_1 - r_2)\, v_1/(x_1 - x_2)\, v_1'$, where $v_1 =$ the potential of the electroscope when it is in contact with the sphere of radius r_1, which had been originally at a potential V, $v_1' =$ the potential of the electroscope after the sphere is removed, $x_1 = v_1/(V - v_1)$ and $x_2 = v_2/(V - v_2)$. In deducing the above formula it is assumed that, if c is the capacity of the sphere of radius r under the conditions of the experiment, $c - r$ is very little dependent on r, provided r is sufficiently great. This assumption is justified by experiment. T. P. B.

1237. *Mechanical Tension on the Surface of a Charged Conductor.* **E. F. Burton.** (Cambridge Phil. Soc., Proc. 16. No. 6. pp. 462–464, April 22, 1912.)—The author describes a simple apparatus for demonstrating experimentally the existence of a real mechanical tension over the surface of a charged conductor. As the greatest possible value of this tension in air is only about 0·3 mm. of mercury, it is very difficult to observe directly. It can be shown by blowing two soap-bubbles one at each end of a tube, and observing the effect of the electrification. If both are unelectrified, the smaller one grows smaller at a continually increasing rate. By electrifying the smaller one, however, this effect can be reversed, the larger, unelectrified bubble becoming smaller. A convenient apparatus for showing this is described. A. R.

1238. *Atmospheric Potential Gradient at Kremsmünster*, 1902–11. **P. A. Blumenschein.** (Akad. Wiss. Wien, Ber. 121. 2a. pp. 25–61, Jan., 1912.)—A Benndorf apparatus for continuous registration of potential gradient [see Abstract No. 576 (1908)] has been in operation since 1902 at Kremsmünster in Austria, where there is an observatory situated near the foot of the Alps, 400 m. above sea-level; and the author gives a general account of the results obtained in the ten years 1902–11. The radium collector of the recording apparatus is exposed from the third story of the observatory, and the records are reduced to the true undisturbed potential "in the open" by applying a factor obtained from a comparison of the records with simultaneous absolute observations made on the level, for which a lighted taper is used as the collector. The conversion factor is found to be independent of the season or hour on all fine days, being constant and about 7·9. On rainy and windy days the factor is usually less, while during snow it is greater than the normal. On days of low fog covering the plains but not reaching so high as the recording apparatus, the factor sometimes rises to ten times its normal value. Hourly tabulations were made only on days noted as "fine" in the meteorological diary, provided also that the curves showed that electrical conditions were undisturbed, and means for each month at every hour of the day are given *in extenso.* The mean value of potential gradient derived from the tabulations is 106 volts/m. The gradient has a maximum (157 volts/m.) in Jan., and a minimum (76 volts/m.) in June. The mean diurnal variation at all times of the year shows minima and maxima constantly at 4 a.m. and 8 p.m. respectively. Other variable maxima occur shortly after sunrise and sunset, and these are stated to be connected with condensation processes. Harmonic analysis of the diurnal variation shows that the amplitude of the primary wave is usually considerably greater than that of the secondary, except in May and June in many years, when the secondary wave is more conspicuous than the primary. The general character of the curves which were left untabulated is compared with the corresponding meteorological conditions. Fog appears to be charged mainly with positive ions, for it diminishes the gradient, whereas dry snowfall increases it. During rain the gradient is negative 3 hours out of 4, but the percentage of positive gradient increases with the intensity of fall, there being 10 per cent. of gradient with a positive sign for a rainfall of 0·2 mm. per hour, and 40 per cent. of positive gradient for a fall of 9·0 mm. per hour. Days with cumulus or cirrus cloud are generally normal electrically, except that the average gradient is 5 per cent. lower than usual, but nimbus and stratus clouds gives disturbed curves with many excursions to the negative side. R. C.

1239. *Motion of Electrons in an Electromagnetic Field.* **T. De Donder.** (Comptes Rendus, 154. pp. 1791–1792, June 24, 1912.)—A mathematical treatment, using the ordinary electric potential V and the components F, G, and H of the vector potential. E. H. B.

1240. *Electron Theory for Metals.* **G. Jaffé.** (Phys. Zeitschr. 13. pp. 284–287, April 1, 1912.)—A mathematical discussion of the electron theory in its application to metals, with references to the researches of W. Nernst and of F. A. Lindemann [see Abstracts Nos. 624 and 1702 (1911)]. E. H. B.

1241. *Theorem of Sufficient Cause and Electromagnetic Field.* **H. Witte.** (Deutsch. Phys. Gesell., Verh. 14. 11. pp. 581–595, June 15, 1912.)—Follows E. Gehrcke in his application of the theorem of sufficient cause to the vectors in the electromagnetic field, and discusses the subject from the standpoint of the relativity principle. [See Abstract No. 898 (1912).] E. H. B.

1242. *Application of the Theorem of Sufficient Cause to Fundamental Electromagnetic Phenomena.* **K. Lichtenecker.** (Deutsch. Phys. Gesell., Verh. 14. 10. pp. 541–545, May 30, 1912.) [See Abstract No. 898 (1912).]

DISCHARGE AND OSCILLATIONS.

1243. *Mean Free Path by Direct Measurement.* **J. Franck** and **G. Hertz.** (Deutsch. Phys. Gesell., Verh. 14. 11. pp. 596–604, June 15, 1912.)—Using an incandescent wire (previously prepared) positive ions were emitted in the electric field of a vacuum chamber and their mean free path, λ, directly measured. With a voltage of 4 volts and pressure 0·068 mm. of mercury, λ = 2·06 mm. Reducing the pressures by calculation to 1 mm. of mercury, the values of λ for 4, 8, 20, and 40 volts were respectively 0·140, 0·149, 0·154 and 0·157 mm. E. H. B.

1244. *Velocity of Ions in Dried Gases.* **R. T. Lattey** and **H. T. Tizard.** (Roy. Soc., Proc. Ser. A. 86. pp. 349–357, April 25, 1912.)—A method has been described by which the velocities of both positive and negative ions produced by Röntgen rays can be measured in very dry gases and some measurements for ions in air have been given [see Abstract No. 1308 (1910)]. These measurements have now been extended to CO_2 and hydrogen, and calculations based on the work of Townsend [Abstract No. 1541 (1911)] show that while the positive ions retain a large envelope of matter even under the influence of a fairly large field of force, the negative ions become considerably diminished in size when their velocity is increased either by an increased force or by diminished pressure. It does not seem to have been previously noted that negative ions are far more readily deprived of their customary envelope in a very dry gas than in a comparatively moist atmosphere. It has been shown that the velocity of ions in air is a function of x/p, where x is the potential gradient and p the pressure of air in the apparatus, and this function is independent of the actual values of either x or p, but is considerably affected by minute traces of moisture. The apparatus used in the present experiments is the same as that previously described, except that the soda-lime tube is removed before CO_2 is admitted. It is found that the velocities of positive ions in CO_2 are proportional to x/p, while the velocities of positive ions in dried hydrogen appear to increase slightly with x/p. Zeleny's and Blanc's observation that positive ions travel faster in moist than in dry CO_2 is not confirmed. The velocity of negative ions in dried CO_2 and in dried hydrogen increases more rapidly than x/p. In all cases these velocities for comparatively small values of x/p approximate to a linear function of that quantity. The values of vp/x for these small values of x/p is compared with those obtained by other observers. Since the positive ions show a linear relationship between v and x/p, the ordinary formula $D = 3{\cdot}21 \times 10^{-6}\, vp/x$ may be applied. From this an approximate value for the molecular masses of the ions may be obtained by using the formula $D^2 m_1 m_2 = K^2$; m_1 and m_2 being the molecular masses of the gases between which diffusion is taking place, and K being a constant. From the results given it appears that the positive ion has a large mass, and is probably an aggregate of at least 25 molecules of the gas in which it is formed, clustered round an electronic nucleus. The negative ion in a dried gas also appears to have an envelope of molecules about its electronic nucleus, and when a certain velocity is exceeded the electron is partially deprived of this envelope by its collision with the molecules of the gas. This will increase its mobility in two ways: (1) on account of the decreased mass of the ion its acceleration between impacts will be increased; (2) its decreased radius will give it greater freedom from collisions. Values here given for the molecular mass must be regarded as the average value of the mass of the group of molecules associated with the electron.

Since this mass becomes smaller than that of an air or CO_2 molecule—and probably also than that of a hydrogen molecule—it is clear that in these gases the electron must have free existence during some part of its course. The envelope of an electron may consist of water molecules or of molecules of the gas in which it is moving. With increasing velocities this envelope is more easily removed the fewer the water molecules present, and it would appear therefore probable that the envelope in dry gases consists of molecules of the gas, and that these are more easily removed than water molecules. A. E. G.

1245. *Conductivity of Ionised Air. Effect of Red Light.* **K. Bergwitz.** (Phys. Zeitschr. 13. pp. 513–514, June 1, 1912.)—Rosselet, in a communication to the International Congress on Radiology, Brussels, 1911, has described research from which he concluded that the effect of light of long wave-length is to reduce the conductivity of ionised air. In the present paper experiments are described which show that the effect observed by Rosselet does not exist in air ionised by the β-radiation of a radium preparation. Rosselet's results are discussed, and it is concluded that it is improbable that such an effect should exist. A. W.

1246. *Ionisation by Collision in Helium.* **E. W. B. Gill and F. B. Pidduck.** (Phil. Mag. 23. pp. 837–849, May, 1912.)—The theory of ionisation of gases by collision due to Townsend has been experimentally verified for a large number of gases, among them being helium. In the first experiments made by the authors with He, the gas contained about 2 per cent. of impurity, and there was good reason for supposing that these slight traces of impurity, exercised a considerable effect upon the ionising powers of the ions. Great care is now taken to purify the gas, with the result that the impurities are found to have a much greater effect upon the positive than upon the negative ions; the explanation given being that they more readily attach themselves to the slow-moving positives than to the much faster negatives. The positives thus loaded are less effective in producing fresh ions by collision, because they are longer in reaching the critical velocity necessary for ionisation. Experiments upon the velocities of positive ions in He should give interesting results. The minimum sparking potential attained, 156 volts, is far below that observed with any other gas; those of nitrogen (298 volts), argon (233 volts), and hydrogen (273 volts) being the three lowest previously obtained. The sparking potential rises from 156 to 187 volts when less than 1 per cent. impurity is present. A. E. G.

1247. *Mobility of Ions in Gases, especially in Mixtures.* **K. Przibram.** (Phys. Zeitschr. 13. pp. 545–547, June 15, 1912.)—In the main a mathematical paper, in which, starting from the equation given by Maxwell for the number of collisions per sec. per $cm.^3$ between two kinds of molecules, relatively simple formulæ are obtained for the mobility of ions in pure gases and mixtures. Tables are given in which calculated results for positive and negative ions are compared with those obtained by Blanc with mixtures of CO_2 and H, and CO_2 and air: also for positive ions as observed by Wellisch in a mixture of H and CH_3I. The calculations are in good agreement with the observed results. A. E. G.

1248. *Kathode Volatilisation of Metals.* **V. Kohlschütter and A. Noll.** (Zeitschr. Elektrochem. 18. pp. 419–428, June 1, 1912.)—Without suggesting the formation of compounds, when metals are volatilised in different gases, the authors point out that the metallic deposits obtained by kathode volatilisation in different gases (H, N, A) are quite different in appearance and behaviour. Platinum volatilised in argon, *e.g.* causes a most energetic combination of H and O to water, while a Pt-deposit produced in a hydrogen atmosphere has a very much weaker catalytic effect. The new experiments are chiefly made with silver. The volatilised silver particles (from a wire kathode) pass through a mica slit and settle on a glass rod, into the ends of which gold-foil has been burnt, so that the silver film forms a bridge between the two gold electrodes of a Wheatstone bridge. Thus conductivity measurements can be taken during the experiments, and the silver film can further be dissolved off with nitric acid for a fresh experiment; silver was selected for this reason. The volatilised metal is further deposited on an object-glass for continuous observations within the bulb. It results that the resistance of a silver film, deposited in a hydrogen bulb, decreases as the deposit becomes denser. When the film is afterwards left to itself, the resistance still decreases to a minimum and then increases and becomes infinite. The apparent reason is that the particles undergo a condensation leading to the formation of larger aggregates and finally to splitting of the film. In nitrogen, and still more in argon, the silver particles are finer to start with; hence a smaller quantity of deposited silver conducts, in the first instance, better when deposited in a hydrogen atmosphere than a greater quantity of silver deposited in argon. Any air present oxidises the silver, especially the most finely divided, already at 100°. The gradual increase in the resistance of the metallic films can be retarded by increasing the gas pressure in the discharge bulb; the gas seems to act like a liquid dispersing agent in colloidal sols. H. B.

1249. *Measurement of the Energy in Canal Rays.* **B. Sáxén.** (Ann. d. Physik, 38. 2. pp. 319–354, May 28, 1912. Extract from Dissertation, Helsingfors.)—The object of the experiments is the comparison of the heat generated by the canal rays with the quantity of electricity transported. The principle of the method adopted is as follows: The bundle of the canal rays is intercepted by a Faraday cylinder, the base of which forms a sensitive thermometer. The base is covered with a layer of metal. The energy so measured is compared with the heat indicated by a similar thermometer without Faraday cylinder, but otherwise under like conditions. The difference gives a measure of the heat energy lost by reflection or emission. Cu and Au are used as reflectors in hydrogen and also in oxygen. The results indicate that when canal rays impinge on a metallic surface all the energy is absorbed. The amount of secondary radiation increases with the discharge potential, and also with the angle of incidence of the rays. The secondary radiation from Au is greater than with Al. The secondary radiation in oxygen appears to be smaller than that in hydrogen. About 80 per cent. of the canal-ray particles are positively charged, while the remaining portion is neutral. The secondary radiations from several other metals are also considered. A. E. G.

1250. *Discontinuous Discharges in Vacua.* **G. Valle.** (Akad. Wiss. Wien, Ber. 121. 2a. pp. 63–93, Jan., 1912.)—In a given tube it is possible, under conditions, to have several kinds of discontinuous discharges, which all consist in a play between partial discharges and statical conditions, the partial discharges being of different character in the different cases. Two such different characters were found in certain tubes under small resistances.

The first has a longer glow and a greater frequency. Both kinds give glows increasing in length as the resistance diminishes, and also increasing current and increasing frequency at points removed from a transition-point. Between the limits of resistance within which both kinds are possible, the combined discharge is normal. The combined discharge consists of groups, in each of which one discharge of the first kind is followed by one or more of the second kind; and the pitch of the note heard in the telephone corresponds to the group frequency. The number of partial discharges in a group increases with decreasing resistance, and probably also with increasing e.m.f. of the battery. As the resistance is reduced, the changes of character are abrupt, with corresponding abrupt changes in the current-strength. Various incidental effects upon the discharge are described. A. D.

1251. *The Water-film on Glass and Aluminium, and its Influence on the Pressure in Vacuum Tubes.* **E. Cohnstaedt.** (Ann. d. Physik, 38. 1. pp. 223–238, May 7, 1912.)—The generation of gas in vacuum tubes, when a current is first of all passed through, has, up to the present, been attributed to the liberation of the gas absorbed by the electrodes. In the present experiments a differential method is employed, by which the gas emanating from the walls of the tube is excluded, and that escaping from the metallic surface is measured. With 1 cm.^{2} of Al surface about 0·8 mm.^{3} of gas is given off, when the pressure in the tube is about 0·02 mm. There is a close connection between the amount of gas given off and the quantity of moisture in the air, in which the metal-foil has been previously placed. From this it follows that the amount of gas does not depend on the volume of the metal, but only on the area of its surface. The hypothesis is then stated that this phenomenon is not due to the gas absorbed by the metal, but can be traced to the evaporation of the film of moisture from its surface. To establish this, experiments are carried out with air dried by means of P_2O_5, with tubes into which hydrogen is led, and also on the mode of regeneration of the moisture film. A. E. G.

1252. *Demonstration of Resonance Curves with the Braun Tube.* **E. Marx** and **F. Banneitz.** (Phys. Zeitschr. 13. pp. 518–520, June 1, 1912.)—Undamped oscillations from a Poulsen lamp are produced in the primary circuit. The kathode beam in the Braun tube is deflected in one direction electrostatically by plates connected to the sides of the capacity of the secondary circuit. The deflection in a direction perpendicular to this is brought about magnetically by a current which is made to vary synchronously with the secondary capacity. This is accomplished as follows:—The secondary capacity consists of two condensers in parallel, the smaller of the two being used for tuning. As the spindle of the tuning condenser is rotated, it cuts out or puts resistance into the current circuit, which is used for deflecting the beam. To do this, a contact arm fixed to the spindle slips over a ring resistance on the top of the condenser. Two photographs are given of the resonance figures produced. T. P. B.

1253. *New Method of Impact Excitation.* **E. L. Chaffee.** (Amer. Acad., Proc. 47. 9. pp. 267–312, Nov., 1911. Electrician, 69. pp. 90–92, April 26, 1912. Abstract. Frank. Inst.. Journn. 173. pp. 437–473, May, 1912.)—The author describes a form of gap for quenched sparks for which special advantages are claimed. Actually the metals used are Al as kathode and Cu as anode, in an atmosphere of moist hydrogen. The gap is at present only capable of furnishing some 45 watts of h.f. output at 100 m. wave-length, and is supplied with direct current at 500 volts. The p.d. across the gap is about 100 volts. Several gaps can be put in series, but the efficiency is then much lower. The original paper should be referred to for the influence of coupling, length of gap, &c., and for the data as to efficiency. The remarkably steady nature of the undamped oscillations produced is evidenced by several plates of Lissajous figures, taken with the aid of the Braun tube. The special arrangements employed in connection with the taking of the h.f. oscillograms are dealt with at length. Reference is also made to the advantages of the gap for use in wireless telephony. L. H. W.

1254. *Hertz Experiments with Zehnder Tube.* **L. Zehnder.** (Phys. Zeitschr. 13. pp. 446–449, May 15, 1912.)—A Zehnder tube filled with helium or neon is so sensitive that a town supply at 200 volts may be used instead of a high-potential battery [see Abstract No. 1754 (1910)]. The importance of preventing the oscillations from passing into the supply or battery-circuit by means of self-induction coils is emphasised. T. P. B.

1255. *Lightning Peculiarities.* **J. Bergonié.** (Comptes Rendus, 154. pp. 972–973, April 15, 1912.)—Description of the peculiar manner in which telegraph poles and other gear are sometimes shattered by lightning, with special reference to damage done during a storm on March 20–21, 1912, at Saint-Morillon. C. P. B.

1256. *Electric Discharges.* **K. v. Wesendonk.** (Deutsch. Phys. Gesell., Verh. 14. 10. pp. 514–524, May 30, 1912.)—A discussion of some of the more important of the recent researches upon this subject. A. E. G.

1257. *Nature of Electric Discharge.* **F. E. Nipher.** (Science, 35. May 3, 1912. Chem. News, 106. p. 8, July 5, 1912. Abstract.)—Reports some explosive effects of the electric discharge with comments on its supposed nature. E. H. B.

1258. *Transmission of Kathode Rays through Matter.* **R. Whiddington.** (Roy. Soc., Proc. Ser. A. 86. pp. 360–370, April 25, 1912.)—A more complete account of the work dealt with in Abstract No. 558 (1912).

1259. *The Velocity of the Secondary Kathode Particles ejected by the Characteristic Röntgen Rays.* **R. Whiddington.** (Roy. Soc., Proc. Ser. A. 86. pp. 370–378, April 25, 1912.)

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1260. *Variation of Selenium with Voltage.* **E. E. Fournier d'Albe.** (Roy. Soc., Proc. Ser. A. 86. pp. 452–461, May 8, 1912.)—That the conductivity of selenium depends not only on the illumination but also upon the voltage applied to it is known. Defining a selenium bridge (Minchin) as an electrolytic cell in which the light is used to effect a change in the resistance, not an e.m.f., and calling the decrease of resistance occasioned by voltage the "potential effect"; this latter is $(R_0 - R_v)/R_0$, where R_v, R_0 are the resistances at voltages V and an infinitesimal voltage respectively. Then if R_1 be the resistance at 1 volt, the author finds that $(R_1 - R_v)/R_1 = F \log V$, where F is a constant under conditions otherwise constant. But F may vary considerably (as much as 80 per cent.) in the same bridge under different conditions of illumination, temperature and fatigue. These results are obtained from bridges made with carbon; bridges made with metallic wires give results which deviate from the logarithmic law. Joulean heat is excluded as a cause unless the emissivity of selenium were 10,000 times smaller than that of metals. Possibly the conductivity of Se may be comparable with that of a gas, due to ionisation by collision modified by a subsequent recombination of the ions; but it would be premature to theorise. A. D.

1261. *Capacity and Resistance of Solenoids for Alternating Current.* **W. Lenz.** (Ann. d. Physik, 37. 5. pp. 923–974, April 16, 1912.)—The paper is mathematical and cannot be abstracted. The theory applies to coils of which the length is great in comparison with the diam. and of which the diam. is great in comparison with the pitch of the turns. It is shown that the capacity is independent of the frequency and that, if C be defined as the capacity of unit length of the coil, the total capacity is equal to $lC/3$, where l is the length of the coil. This result is analogous to that for the capacity of a closed double conductor. At the end of the paper approximate formulæ for the resistance and self-induction of coils are given, and compared with the theoretical and experimental results of other workers. T. P. B.

1262. *Contact-potential between Glass and Electrolytes.* **L. Riéty.** (Comptes Rendus, 154. pp. 1411–1414, May 28, 1912.)—From his experiments on the e.m.f. due to the flow of electrolytes through capillary tubes [see Abstracts No. 1286 (1911) and 1098 (1912)] and the theory of Helmholtz, the author deduces the p.d. at the contact between glass and electrolyte by measuring the viscosity (after Poiseuille) and the conductivity of the solution (Lippmann). He finds for copper sulphate a p.d. of 0·51 volt at concentration 1/250 gm.-mol. per litre, of 0·12 volt at 1/100, of 0·159 volt at 1/10, and of 0·56 volt at concentration 1; there is thus a distinct minimum at concentration 1/100 gm.-mol. per litre. In zinc sulphate the minimum of 0·31 volt is found for concentration 1/20 (0·71 volt at 1/40, 0·64 volt at 1); in copper nitrate the figures are: 1/10 concentration, —0·87 volt; 1/2 concentration, —0·28 volt; 1 concentration, —0·86 volt. H. B.

1263. *Flow through Glass Capillary Tubes.* **E. Oettinger.** (Phys. Zeitschr. 13. pp. 270–276, April 1, 1912.)—A continuation of work previously dealt with [Abstract No. 1965 (1909)]. The object of the present research was to test the validity of the Helmholtz and Lamb formulæ for the p.d. between two points of the capillary tube. The experiments with various solutions showed that the formulæ are in the main correct, though they give much too high values for $(\phi_i - \phi_a)$, the p.d. between the solid walls and the fluid, and also much too high values for the difference $(\phi_{\text{acid}} - \phi_{\text{base}})$. A. W.

1264. *Electrical Units.* **E. B. Rosa** and **F. A. Wolff.** (Washington Acad. Sci., Journ. 2. pp. 259–267, June 4, 1912.)—A brief description of the work of an international committee consisting of W. Jaeger of the Physikal.-Techn. Reichsanstalt (P.T.R.), F. Laporte of the Laboratoire Central d'Electricité (L.C.E.), E. B. Rosa and F. A. Wolff of the Bureau of Standards (B.S.), and F. E. Smith of the National Physical Laboratory (N.P.L.), who met at Washington in April and May, 1910. The results of comparisons of resistance coils showed that the units of resistance employed in the different laboratories differed by the following amounts:—

Ohm N.P.L. − Ohm P.T.R. = 10×10^{-6} ohm
" N.P.L. − " B.S. = 12 " "
" N.P.L. − " L.C.E. = 105 " "

A considerable number of Weston normal cells were taken to Washington for comparison of their values. The differences, in microvolts, between the separate groups and the mean of all are given in the following Table :—

Number of Cells.	April 7.	April 11.	April 22.	May 10.	May 16.
P.T.R. 15	+1	0	+1	+1	0
N.P.L. 84	−8	−1	−1	0	−2
L.C.E. 15	+10	+10	+8	+8	+10
B.S. 40	−8	−8	−8	−8	−9

A considerable number of experiments were made with the silver voltameter, the object being to determine the e.m.f. of the Weston normal cell in terms of the international ohm and international ampere. In some of the experiments certain of the delegates exchanged materials and used the apparatus of one another. Four different forms of voltameter were in general use. There was a difference of opinion among the delegates as to how the results should be weighted in taking the mean, but for the purpose of stating the value of the Weston normal cell to 5 figures it makes little difference how the results are combined. The Committee recommended the value 1·0183 international volts at 20° C.
F. E. S.

1265. *The Vibration Galvanometer and its Application to Inductance Bridges.* **S. Butterworth.** (Phys. Soc., Proc. 24. pp. 75–93 ; Discussion, pp. 93–94, Feb., 1912.)—The author divides vibration galvanometers into two classes. In the first class the moving parts possess only one degree of freedom, and in the second they possess an infinite number of degrees of freedom. The theory of the vibration galvanometer of the first class when placed in circuits containing inductance and capacity is worked out. It is shown that whatever the conditions of damping the best conditions are obtained : (*a*) When the e.m.f. is in phase with the current, and (*b*) when (displacement constant)^2/(impedance)^2 = (damping constant)/(resistance). When the best conditions are attained the amplitude of vibration depends only on the applied e.m.f., the damping constant, and the total resistance of the circuit. In order to secure a large vibration the resistance of the galvanometer should be as small as possible. A similar theory is worked out for galvanometers of the second type provided that the damping is small. The effect of harmonics in this case is also considered. The results are applied in the case of a general inductance bridge. This includes the theory of Anderson's bridge, a modified Rimington's bridge, Heydweiller's modification of the Carey-Foster bridge, and a bridge for measuring frequency. The best conditions for working Anderson's bridge with the vibration galvanometer as detector are obtained.
A. R.

1266. *Protected Galvanometer and Magnetometer.* **J. Kollert.** (Zeitschr. Instrumentenk. 32. pp. 141–148, May, 1912.)—In order to obviate the disturbance caused in galvanometers and magnetometers by passing electric cars, &c., the author recommends the employment of an astatic magnetic system. This is preferable to the use of moving-coil galvanometers which are troublesome on account of their variable damping and their zero shifts. Iron-clad galvanometers are expensive, and they are also objectionable, as large currents passing through the coil often leave some permanent magnetism in the casing. The paper gives constructional details of an astatic galvanometer and magnetometer, and particulars of tests showing their freedom from external magnetic disturbances. A. D. R.

1267. *Demonstration of Phase-difference of Two Alternating Currents.* **A. Lindemann.** (Phys. Zeitschr. 13. pp. 449–450, May 15, 1912.)—A piece of apparatus is described which may be used to show the phase-difference of two alternating currents of the same frequency. On the poles of an electromagnet are mounted two small sheets of iron, in each of which an opening is cut. One of these sheets carries a piece of wood on which are fixed two brass strips placed at right angles. The strips are clamped at one end and their free ends are at the opening in the piece of iron. The length of the strips is such that the natural period of their vibration is the same as that of the alternating currents to be tested. The free ends of the strips carry pieces of tin-foil in which two slits are cut at right angles to each other. Lissajous figures are thus obtained in the usual way, when the alternating currents are conducted through the strips, flexible connections being made to the free ends of the strips for this purpose. T. P. B.

ALTERNATING CURRENTS AND MAGNETISM.

1268. *Magnetic Anisotropy of Iron.* **G. Vallauri.** (Phys. Zeitschr. 13. pp. 314–316, April 15, 1912.)—The author doubts the accuracy of Gans's finding that iron electrolytically deposited in a magnetic field shows no magnetic anisotropy, and considers that Gans's result was due to his using very strong fields. Employing a tube of iron which could be magnetised by an axially or circularly applied field, Villauri finds a considerable anisotropy which diminishes with increased intensity of the applied magnetising force. A. D. R.

1269. *Analytical Representation of Magnetisation Curves.* **E. Madelung.** (Phys. Zeitschr. 13. pp. 436–440, May 15, 1912.)—The author points out that in an I-H diagram any secondary hysteresis loop is definitely defined by its reversal points, and further, that any complete minor loops made in either branch of such a curve will not appreciably alter the relations between I and H in the larger loop when it is subsequently repeated. Accordingly the slope with which a curve commences is a pure function $\phi(I)$ of the magnetisation. Gans has shown that $\phi(I)$ has a universal character in that it is, with the exception of a constant, independent of the material. It goes through the same variations as the value of dI/da as a function of I when we write $I = I_0(\coth a - 1/a)$, where a is a quantity proportional to the field H. This gives a rule for the complete course of a magnetisation curve. For if H_1 is the field strength at the reversal point, then for two points with the same value of I and the same $(H - H_1)$, dI/dH must be the same; that is, dI/dH is determined by I and $(H - H_1)$, or $dI/dH = \phi(I) . f(H - H_1)$. The author gives an account and examples of the experimental method of determining these functions, and indicates how this analytical investigation throws light on the isotropy or anisotropy of various magnetic materials. A. D. R.

1270. *Influence of Silicon on Iron.* **P. Paglianti.** (Metallurgie, 9. pp. 217–230, April 8, 1912.)—A series of iron-silicon alloys containing 0·2 to 5 % Si were prepared in an electric furnace by adding 50 % ferro-silicon to electrolytic iron. The materials were thereafter tested in the condition as cast, and after annealing and quenching. The exact chemical composition was determined, and the alloys were tested for strength, elongation, resistance to scratching and indentation, specific gravity, microstructure, electric conductivity, and magnetic properties. The chief results are:—(1) Silicon increases the elasticity and hardness and raises the elastic limit, but lessens the elongation and contraction of the metal in all its conditions. (2) The Brinell hardness numbers increase fairly uniformly with the Si-content from 125 with 0·2 % Si to 290 with 5 % Si. (3) The specific gravity diminishes regularly from 7·87 to 7·57 over the same range. (4) The specific electrical resistance varies from 16 to 65 microhms-cm. It is noteworthy that the resistivity is the same for the cast, annealed, and quenched conditions of the alloys. (5) The magnetic properties of the iron are much affected by the presence of Si, especially in the annealed condition of the material. The addition of Si improves the magnetic quality, the best results being obtained with 2 % Si. (6) For high inductions the magnetic permeability falls off with increase of Si, but for $B < 7000$ there is a considerable enhancement of the quality with the addition of Si. (7) With the annealed alloys the max. value of μ was 1500 with 0·2 % Si, 3300 with 2 % Si, and 2800 with 5 % Si. (8) For $B = 13{,}000$ the hysteresis loss with 2 % to 5 % Si was only about half that with 0·2 %. A. D. R.

1271. *Effect of Magnetism on Chronometers and Watches.* **S. Chapman** and **T. Lewis.** (Roy. Astronom. Soc., M.N. 72. pp. 583–608, May, 1912.)—The original object of the experiments was to ascertain that intensity of magnetic field which will produce a change of 1 sec. in the daily rate of a chronometer, but the investigation has been extended. The fields were produced by the stray field of the large electromagnet of a disused dynamo, the armature of which had been removed. A neutral point was determined, and the earth's horizontal field being known as 0·18, the field at any point was calculated by the inverse cube law. Tests were made on six chronometers and on several ordinary and "non-magnetic" watches. It was found that a field of 1 c.g.s. unit may change a chronometer's daily rate by 1 sec., the change being temporary and vanishing on removal of the field. The change in rate alters in sign for a horizontal watch as it is turned round in azimuth, and for four certain positions the change is zero. "Non-magnetic" watches (usually with palladium balances, escapement, and hands, but with steel mainspring, pivots, arbors, ratchet and keyless work) were very satisfactory, the change in rate being negligible for fields up to 20 c.g.s. units. When placed directly between the poles of the electromagnet, the change in the daily rate was less than 2 min. Iron box shields were also found very efficient as protectors against magnetisation. The experiments, taken as a whole, seem to show that the observed changes in the rate of ordinary watches are due principally to the steel in the balance. A formula is derived for determining the change in daily rate of a watch placed in a magnetic field of known character, and examples of its use are given. These show fair agreement with the experimental results. A. D. R.

1272. *Earth-magnetism.* **Angenheister and Ansel.** (Gesell. Wiss. Göttingen, Nachr., Math. Phys. Klasse, 1. pp. 42–75, 1912.)—A discussion is given of the earth-magnetism observations made during the Iceland Expedition in the spring of 1910, chiefly in relation to the variations of solar activity as shown by spots, faculæ, and corona. Tables are given of the detailed observations, and curves showing the mean variations at Dyrafjord compared with the traces obtained at Batavia and Potsdam. C. P. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1273. *Carbon-monoxide Detector.* **R. Nowicki.** (Elektrochem. Zeitschr. 19. p. 85, May, 1912.)—A U-tube, fitted with two stopcocks, is fixed within a wider glass tube. By working a rubber balloon the glass tube is charged with the air to be analysed. If the air contains CO, a strip of paper moistened with palladious chloride turns brown; when the CO-content exceeds 0·1 per cent. this takes place within a minute. The pocket apparatus is made by C. Glatzel, of Mährisch Ostrau, Austria. H. B.

1274. *Radio-activity and Molecular Structure.* **W. A. D. Rudge.** (Cambridge Phil. Soc., Proc. 16. No. 6. pp. 465-480, April 22, 1912.)—A number of physical and chemical changes have been studied in which some intermolecular changes might be assumed to occur. These changes included the conversion of magnetic nickel into the non-magnetic state and the change from acidic into basic iron. No effect of a radio-active character was observed. The experiments show that hydrocyanic acid gas when prepared by heating ferrocyanic acid is very strongly ionised. The residue left after heating the ferrocyanic acid has the power of ionising air, and retains this for a considerable period. E. M.

1275. *Solubility of Wrought Tungsten and Molybdenum.* **W. E. Ruder.** (Amer. Chem. Soc., Journ. 34. pp. 387-389, April, 1912.)—Describes tests made on discs of sheet tungsten, 18 mm. in diam. and 2 mm. thick, with hydrochloric, sulphuric, nitric, and hydrofluoric acids, aqua regia, alkaline carbonate, and potassium hydroxide. At room temperature the first three acids, strong or dilute, have no effect, except in the case of dilute nitric acid, which produces yellow surface oxide. Fused KOH attacks the metal slowly. Hydrofluoric acid, hot or cold, does not attack W, in contradistinction to Ta; but mixed HF and HNO_3 solution dissolves W, with production of tungstic oxide. Molybdenum is much more easily dissolved than W. It resists concentrated HCl and H_2SO_4 below 125° fairly well, and is untouched by HF. L. H. W.

1276. *Volatility of Metals of the Platinum Group.* **W. Crookes.** (Roy. Soc., Proc. Ser. A. 86. pp. 461-477, May 8, 1912. Chem. News, 105. pp. 229-232, May 17, and pp. 241-243, May 24, 1912.)—A vertical Heræus furnace, consisting of porcelain tube, closely wound with Pt-ribbon, 0·01 mm. thick, and a crucible inside the tube, broke down three times in the course of two years by fusion of the Pt at some weak spot. The glistening dust on the porcelain consisted of beautiful hexagonal plates of Pt. These experiments suggested a greater volatility of platinum than had been assumed; experiments were therefore made with the platinum metals, first at 1300° C. and then at 900° C. A Pt-crucible lost at 1300° 0·245 per cent. of Pt in 30 hours; the Pt surface looked unchanged; the furnace being covered at the top, there was no air-washing (impinging of air on the hot metal). Palladium lost 0·745 per cent. in 30 hours; the loss was partly due to the liberation of occluded gas; the heated metal assumed a moiré appearance. Iridium (a crucible) lost 7·8 per cent. in 22 hours; it turned moiré and began to disintegrate. Rhodium lost only 0·131 per cent. in 30 hours and did not change beyond tarnishing.

Ruthenium oxidised and lost 25 per cent. in 8 hours. At 900° C. (full orange heat, produced by a Méker burner) all the metals proved much less volatile. Platinum did not change at all; palladium turned slightly pink; iridium lost 0·1 per cent. in 22 hours; rhodium remained unchanged. Platinum appears to be volatile as such at high temperatures. Iridium mostly volatilises as oxide, but also as metal; the author enclosed some Ir in an exhausted silica tube with a bulb at its end and obtained a black deposit of metallic Ir in the cool end of the tube. H. B.

1277. *Experiments on the Condensation of Metallic Vapours.* **V. Kohlschütter and C. Ehlers.** (Zeitschr. Elektrochem. 18. pp. 373–380, May 15, 1912.)—Experiments have been made on the volatilisation of As, Se, Cd, and Zn *in vacuo* and in various inert gases at different pressures. The metals were sublimed and allowed to condense on an object-glass which was afterwards examined under a microscope for size and closeness of packing of the particles. The results show that the size of the particles decreases, and the number per unit area increases, as the pressure of the gas increases. Further, the subdividing power of a gas increases with its density. As a possible explanation of the phenomena it has been suggested that the molecular mobility (causing the Brownian motion of suspended particles) influences the size of the sublimate, since it opposes the surface and cohesive forces tending to bring about a diminution of volume of the condensing vapour. [*Errata*, p. 456, June 1, 1912.] F. A. C. H. L.

1278. *Strength of Rolled Zinc.* **H. F. Moore.** (Univ. of Illinois, Bull. No. 52. Eng. News, 67. pp. 862–864, May 9, 1912. Abstract.)—Gives the results of tension, punching, shearing, and cold bending tests of rolled zinc and also some tests of cast zinc. A considerable variation was found in the strength of cast zinc specimens, depending on temperature of pouring &c., the ultimate strength ranging from 6050 lbs. per sq. in. to 12,220 lbs. per sq. in., whereas in the case of rolled zinc the extreme values obtained were in general within 10 per cent. of the mean. For plates under 0·05 in. thick, the ultimate tensile strength is about 24,000 lbs. per sq. in.; for plates over 0·05 in thick, 21,000 lbs. per sq. in. is about the figure. Rolled zinc is somewhat stronger across the grain than with the grain. A higher figure was obtained for rolled zinc by increasing the rapidity of application of the load. Zinc, either rolled or cast, has no well-defined yield-point, and its elastic limit is very low. The modulus of elasticity of zinc in tension is about 11,500,000 lbs. per sq. in. The results of the punching and shearing tests of zinc plate show an average value of shearing stress developed of 19,400 lbs. per sq. in. for the punching tests and of 17,100 lbs. per sq. in. for the shearing tests. The average value of the energy required was 8110 lbs. per sq. in. per inch of thickness for the punching tests, and 4850 lbs. per sq. in. per inch of thickness for the shearing tests. The ductility of rolled zinc is much less than that of mild steel, and the ductility of the plates with the grain is greater than the ductility across the grain. C. O. B.

1279. *Confirmations of the Theory of Allotropy.* **A. Smits and H. L. de Leeuw.** (Konink. Akad. Wetensch. Amsterdam, Proc. 14. pp. 1199–1216, May 23, 1912.)—The authors have studied the melting and solidification of mercury, tin and water, in order to confirm the theory of allotropy previously enunciated [see Abstracts Nos. 690, 691 (1911)]. Exceedingly rapid heating is required to bring about the superheating of mercury, but supercooling takes place comparatively easily. Heterogeneous equilibrium sets in rapidly on heating, but very slowly on cooling. The "unary" melting-point of tin was found to be 231·82° C., but in accordance with the complex nature of the substance, both supercooling and superheating take place very readily. By allowing equilibrium to set in at 165° C. the melting-point can be raised to 238° C. Ice does not behave ideally if it be kept below 0° C. for any length of time, prolonged exposure to very low temperatures sometimes raising the final melting-point to above 0° C. F. C. A. H. L.

1280. *Crystallisation and Structure of Slowly-cooled Steel.* **N. T. Belaiew.** (Rev. de Métallurgie, 9. pp. 321–342, May, 1912.)—The author has studied the crystallisation and structure of iron-carbon alloys containing less than 2 per cent. C. All the alloys were kept molten for 2 hours and then allowed to cool under such conditions that 60 hours elapsed while the temperature fell from 1500° C. to 300° C. During solidification "primary crystallisation" occurs with the formation of interlocking dendrites built up of octahedral crystals. Under favourable conditions, the dendritic structure is visible to the naked eye, but can always be developed by prolonged etching of polished specimens. There are decided indications that the resulting solid solution is non-homogeneous. During the solid solution range neighbouring octahedra of similar orientation aggregate to form polygonal grains. At the eutectoid temperature, the so-called secondary crystallisation takes place with the deposition of ferrite or cementite which form envelopes for the pearlite grains and give rise to the cellular structure. The secondary crystallisation is influenced markedly by the foregoing phenomena. If the secondary crystallisation occurs very rapidly the structural constituents (ferrite and cementite) arrange themselves parallel to the four surfaces of the octahedron and form Widmanstätten figures inside the grains. This combination of the network and Widmanstätten figures has been called the Widmanstätten structure. Examination of the structure of isolated crystals which have developed in cavities shows that the axes of the dendrites coincide with the lines of deposition of the ferrite and cementite. Such a structure is called the "structure of large crystals." F. C. A. H. L.

1281. *Tensile Strength of Aluminium-Zinc Alloys.* **W. D. Bancroft.** (Rev. de Métallurgie, 8. p. 785, 1911. Metallurgie, 9. pp. 235–236, April 8, 1912.)—The alloys were prepared in graphite crucibles and poured at a temperature 50 deg. C. above their melting-points into graphite moulds. When sufficiently set the ingots (200 × 28·1 mm.) were quenched in ice-cold water. The concentration-strength curve shows three branches: an increase of strength from 0 to 4 % Al, a maximum between 4 and 50 % Al, and a drop between 50 and 100 % Al, corresponding with Shepherd's diagram [see Abstract No. 1959 (1905)]. By heat treatment the properties of the alloys can be varied considerably. F. C. A. H. L.

1282. *Contraction of Antimony-Lead and Aluminium-Zinc Alloys during and after Solidification.* **D. Ewen** and **T. Turner.** (Rev. de Métallurgie, 8. p. 728, 1911. Metallurgie, 9. pp. 233–235, April 8, 1912.)—Antimony expands considerably while lead does not alter in volume during solidification. Their alloys show two maxima—one at the eutectic point, and the other at 50 per cent. Pb—and two minima. The curve cannot be reconciled with either the thermal equilibrium diagram nor the Shore hardness diagram. In the Al-Zn series, the expansion curve showed a maximum at the eutectic point and in the rest of the curve there appears to be a relation between the expansion and the solidification interval. Shore hardness tests and tensile strength tests indicate the existence of maxima in these values at 20 and 50 per cent. Al. The tensile tests are in close agreement with those of Bancroft [see preceding Abstract]. Cooling-curves of alloys containing 2·4 to 60 per cent. Al show a critical point between 200° and 300° C. which is at a maximum in the alloy corresponding to the composition $AlZn_3$. Quenched from 300° C. an alloy of this composition shows no eutectic. F. C. A. H. L.

1283. *Cobalt-Carbon System.* **G. Boecker.** (Metallurgie, 9. pp. 296–303, May 3, 1912.)—By heating Kahlbaum's cobalt with sugar charcoal in magnesia crucibles heated in an electric carbon-tube furnace, alloys were prepared containing up to 3·9 per cent. carbon which appears to be the saturation-point of Co for carbon at 1700° C. Observation of the cooling-curves shows that the melting-point of Co (1448° C.) is lowered to a eutectic point at 1300° C. with 2·9 per cent. carbon. At 1300° C. the saturated solid solution contains 0·32 per cent. carbon, but as the temperature falls the solubility diminishes and at 1000° C. only about 0·35 per cent. carbon is retained in solution. On slow cooling the carbon separates in the graphitic state. Micrographic analysis confirms these conclusions. F. C. A. H. L.

1284. *The Increase of the Chemical Resistivity of Mechanically Workable Alloys, suitable for Constructional Purposes.* **O. Barth.** (Metallurgie, 9. pp. 261–276, April 22, 1912.)—The object of the research was to find an alloy capable of resisting chemical action and at the same time retaining such properties as would enable it to be worked mechanically. Experiments on the whole series of Co-Sn alloys showed that those containing from 30 to 50 per cent. Co possessed an extraordinary resistivity towards the action of dilute nitric acid, and experience has shown that this is a good guide to the behaviour when exposed to the action of sea-water or atmospheric conditions. The alloys are, however, too brittle to be of any practical use, but by dissolving the 40 per cent. Co alloy in quantities up to 20 per cent. in copper or otherwise preparing cobalt bronzes in which the ratio Co : Sn = 4 : 6, a series of alloys are obtained which have excellent mechanical properties combined with a high resistivity. This increased passivity has been ascribed by the author to the formation of solid solutions of passive metals (Co and Sn), and the view is confirmed by reference to the iron group and similar metals. A similar result was anticipated in the case of Al by the addition of cerium; but although the mechanical properties were considerably improved, the resistivity to the action of dilute acids was found to be diminished. The alloys were prepared by electrolysing cryolite containing cerium fluoride or by heating Al with cerium fluoride to 1000° C. Mechanically, the best alloy was one containing about 0·2 per cent. Ce. Cooling-curves showed that up to 11 per cent. Ce the two metals form solid solution. Microscopic analysis indicates the existence of an insoluble cerium silicide which probably accounts for the increased action of dilute acids on the alloys.

F. C. A. H. L.

1285. *Mechanism of the Formation of Troostite.* **D. K. Bullens.** (Metallurgical and Chem. Engin. 10. pp. 205–207, April, 1912.)—A *résumé* of the opinions and theories put forward by investigators on the nature of troostite is given. It is pointed out that the general tendency of thought at the present time seems to be towards Benedicks' proposition of an ultra-microscopic pearlite, regarding troostite as an aggregate. The author gives the results of a microscopic investigation of nearly pure iron-carbon alloys after heat treatment by the Metcalf test, which gives a continuous structure between and through the critical ranges. He sums up the various transitions as follows: (*a*) Austenite; (*b*) Martensite, appearing as needles; (*c*) Precipitation or change of infinitesimal particles of elementary troostite from the martensite; (*d*) Segregation of elementary troostite to the boundaries of the austenite-martensite grains, forming splotches and globular masses, metallographically known as troostite; (*e*) Differentiation of the troostite into osmondite, together with the precipitation of free cementite in hyper-eutectoid steels; (*f*) Mechanical arrangement of osmondite into sorbite and pearlite. The author believes that the masses known as troostite may generally be termed osmondite. The change after segregation is so rapid that the resolution of the segregated troostite takes place almost immediately, giving osmondite and cementite in hyper-eutectoid steels. C. O. B.

1286. *Action of Ultra-violet Light on Chlorine.* **E. B. Ludlam.** (Phil. Mag. 23. pp. 757–772, May, 1912.)—As ultra-violet light ejects electrons chiefly from electropositive elements, though also from electronegative oxygen, the author tried the highly electronegative chlorine gas, which has a band in the ultra-violet; this band might prevent the ejection of electrons. According to Lenard, under whom part of the research was carried out, a shorter wave-length is necessary in oxygen to produce ionisation than is required to convert the oxygen into ozone. The wave-lengths tried by the author with chlorine and also with air ranged from 440 to 90 $\mu\mu$. There was very little ionisation produced even in dry air by waves of more than 200 $\mu\mu$; with wave-lengths below 180 $\mu\mu$ the ionisation of pure dry air was considerable. A trace of water increased this ionisation enormously. Very small quantities of chlorine also increase the ionisation of air, more chlorine stops it. Pure chlorine itself is not ionised appreciably and does not form condensation nuclei when the illuminated gas is made to impinge against an orifice from which a jet of steam is issuing. Considerable quantities of chlorine destroy any ions and condensation nuclei otherwise formed in the air. Chlorine thus does not appear easily to lose an electron, and traces of foreign matter seem necessary for the ionisation of gases and for their chemical combination; yet actual liberation of electrons for a measurable period of time does not appear to be a necessary precursor of gaseous combinations. H. B.

1287. *Conversion of Starch into Dextrin by X-Rays.* **H. A. Colwell** and **S. Russ.** (Phys. Soc., Proc. 24. pp. 217–221; Discussion, p. 221, June 15, 1912.)—Solutions of starch in distilled water exposed to X-rays of moderate penetrating power in a dish covered with a thin sheet of mica were partly converted into dextrins, 5 per cent. of dextrin being formed in 8¼ hours. This change might also have been produced by hydrolysis; but according to Kernbaum X-rays do not decompose distilled water, so that the X-rays or secondary rays, to which they give rise, would appear to act directly on the starch molecule. Solutions of dextrins were under similar conditions not converted into glucose by X-rays. H. B.

1288. *Ozonisation of Oxygen by α-Rays.* **S. C. Lind.** (Amer. Chem. Journ. 47. pp. 397–415, May, 1912. Akad. Wiss. Wien, Ber. 120. 2a. pp. 1709–1724, Dec., 1911. Le Radium, 9. pp. 104–106, March, 1912.)—The experiments were made in the Institut f. Radiumforschung, Vienna. The source of α-rays is emanation contained in a very thin-walled glass vessel, a capillary with a bulb blown to it, diam. 1 or 2 mm., wall-thickness 0·005 to 0·01 mm. The process of making these vessels, first in Paris in conjunction with Decane, is explained; they are drawn and blown inside a tube of Jena glass. It results that the total number of ozone molecules produced in a given time is equal to the number of ions formed in the same period by the α-rays passing through the oxygen molecules, and it would appear that ozone is formed by the union of an oxygen molecule with a charged atom (ion), and that the oxygen later loses its charge. The quantity of ozone obtained was in some cases equal to the amount required by this ionic theory, in no case greater, but sometimes much smaller. Air at atmospheric pressure yielded as much ozone as oxygen at ⅕ atmo.; the reaction seems thus confined to the oxygen. H. B.

1289. *Viscosity of Ethylene and Carbon Monoxide and its Change at Low Temperatures.* **O. Zimmer.** (Deutsch. Phys. Gesell., Verh. 14. 9. pp. 471–492, May 15, 1912.)—The author has determined the viscosity of ethylene and CO by the transpiration method, at low temperatures. He finds that the change in the coefficient of viscosity of ethylene with falling temperature can be expressed approximately by the formula of Sutherland only down to a temperature of about —20°. Below this temperature the coefficient of viscosity is greater than the value given by the Sutherland formula. In the case of CO the change in the coefficient of viscosity is in harmony with the theoretical formula throughout almost the whole range of temperature investigated; only at the lowest temperatures are slight deviations from the theory found. They are in the same direction as in the case of ethylene. At the temperatures at which a deviation of the coefficient of viscosity from the Sutherland formula occurs, deviations from the Boyle and Gay-Lussac laws are also met with. Such deviations in the coefficients of viscosity as were found, and also the deviations in the density, can be explained by the assumption of polymerisation of the gases. A. F.

1290. *The Ammonia Flame.* **A. C. Egerton.** (Nature, 89. p. 270, May 16, 1912.)—Ammonia burning in oxygen gives a yellow flame, like the nitrogen glow of Strutt, and a similar spectrum. The ammonia seems first to be split up into nitrogen and hydrogen, and the inner, bright yellow cone of the flame is apparently due to the combination of N-atoms to molecules (as in the nitrogen glow), while in the outer hardly luminous cone the hydrogen is burned to water, and some nitric oxide is formed. Flames due to the combination of substances generally have a pointed cone, whilst in the ammonia flame the inner cone assumes a round apex. H. B.

1291. *The Volta-effect and Nernst's Theory.* **J. Villey.** (Comptes Rendus, 154. pp. 1842–1844, May 20, 1912.)—The author supposes that in the electrical double layer existing at the surface of a metal immersed in a solution of its salt the phenomena are partly electrolytic and partly electronic. The difference of potential (V) which exists between the metal and the solution is thus the sum of the electronic Volta-effect (v) and the electrolytic Nernst-effect (ν). The solution tensions of the metals then depend not on V, but on $\nu = V - v$, and the ordinary Nernst formula will be correspondingly modified. The ratio of the solution tensions of zinc and copper becomes reduced to 10^{11} instead of 10^{40}. By assuming that the Volta-effect with gold is negligible, the author deduces that the absolute solution tensions of all the metals are very small, which is more probable than the large value deduced in many cases by Nernst's method. [See Abstract No. 1641 (1905).] T. S. P.

1292. *A Copper-Zinc Uranium Oxide Cell; Contact E.M.F.* **A. Anderson.** (Phys. Soc., Proc. 24. pp. 102–106, Feb., 1912.)—The cell was designed for observing variations in atmospheric temperature, humidity, and pressure. It is a copper vessel containing a copper plate on a copper tripod; the plate is covered with uranium oxide to ionise the air, and a zinc plate rests above on a zinc fork. A pile of this type is also mentioned. The e.m.f. gradually falls from 0·78 in four days to 0·625 volt, and in 8 months to 0·34 volt. The voltage increases with rising temperature, the formula being $E = 0{\cdot}27 + 0{\cdot}002t$. E should therefore vanish at —135° C., while the neutral point of Cu-Zn is —67° C. An explanation of the peculiarity on the electron theory is suggested. H. B.

1293. *Rotating Kathode.* **C. W. Bennett.** (Journ. Phys. Chem. 16. pp. 287–293, April, 1912.)—The author has designed a revolving kathode which can be rotated at a speed of up to 6000 revs. per min., and will carry 800 amps., giving a current density of about 3500 amps. per sq. ft. when 4 in. of the kathode is receiving a deposit. The kathode is so arranged that the deposited metal can be removed for testing in suitable pieces, without bending or heating. If the deposited cylinder is required whole, a thin shell of fusible metal is first cast round the kathode, and after electrolysis the whole is immersed in boiling water. Full constructional details are given. T. S. P.

1294. *Tensile Strength of Electrolytic Copper on a Rotating Kathode.* **C. W. Bennett.** (Journ. Phys. Chem. 16. pp. 294–311, April, 1912.)—On the rotating kathode devised by the author [see preceding Abstract] copper has been deposited at a current density of 4000 amps. per sq. ft., or about 430 amps./dm.². The size of the crystal in the deposited copper decreases as the kathode is rotated more rapidly, and also as the current density increases, but increases with rise in temperature. The tensile strength of the deposited metal varies inversely as the crystal size, so that rapid rotation and high current-density tend to increase the tensile strength. A good deposit of copper could probably be obtained at an infinite current-density if the stirring were efficient enough to prevent local impoverishment. The current efficiency at a high current-density, with rapid rate of rotation, is very good, being 99·6 per cent. When the temperature is kept down, hard-drawn copper can be deposited on a rotating kathode at almost any current density, whilst at 75° C. the product resembles annealed copper. The concentration of the electrolyte may be subjected to considerable variations without affecting the character of the deposit. Electrolytic copper has been obtained having a tensile strength of 68,000 lbs. per sq. in. An attempt has also been made, but not with much success, to find suitable electrolytes and suitable conditions for the deposition of bronze and brass of high tensile strength. The difficulty to be overcome is the formation of colloidal material (*e.g.*, stannic hydroxide), and the electrolyte to be sought for must be an acid solution of readily soluble salts, with no possibility of the formation of colloids. T. S. P.

1295. *Passivity and Valve-action of Iron in Sulphuric Acid.* **G. Schulze.** (Zeitschr. Elektrochem. 18. pp. 326–333, May 1, 1912.)—The experiments were made with rods of wrought-iron, 5 mm. in diam. When active iron is formed in diluted sulphuric acid it turns passive. When the concentration is raised above 50 per cent., valve-action sets in, but it is not stable until the concentration exceeds 75 per cent. From 40 to 70 volts can be throttled; below the max. voltage a weak residual current is observed. Alternating currents are rectified in concentrated acid and in fuming sulphuric acid, and the effect depends, as in the case of Al, upon the water percentage of the acid. The metals Ni and Co, further Ta, Mg, Cd, Zn, Sb, Bi, Cu, Sn behave similarly in sulphuric acid; the valve-effect is very feeble in lead, and is not noticed at all in Ag and Pt. H. B.

1296. *Cause of the Passivity of Iron.* **F. Flade** and **H. Koch.** (Zeitschr. Elektrochem. 18. pp. 335–338, May 1, 1912.)—According to the oxygen-hypothesis pure iron is naturally active and becomes passive by the presence of oxygen; according to the hydrogen-hypothesis iron is naturally passive and becomes active by hydrogen. The third possibility is that the passive state is due to oxygen, the active state to hydrogen, and that the iron is not pure in either case. The authors investigate the problem by heating an active electrode, a piano wire, in a vacuum (discharge tube), withdrawing the hydrogen evolved during the heating. The iron did not turn passive, which is in favour of the oxygen-hypothesis and against the hydrogen-hypothesis. Heated in CO the active electrode slowly turned passive. The difficulty is to decide when iron is active and when passive. They assume that iron has a change-potential, *i.e.*, that it is in N/10 K_2SO_4 solution passive above + 0·87 volt and active below that potential, and they observe, not the change, but whether the insertion of the iron into the electrolyte gives a fairly constant current (active), or whether the current intensity rapidly decreases in a few seconds. H. B.

1297. *Corrosion of Steel in Water.* **G. J. Burrows** and **C. E. Fawsitt.** (Roy. Soc. New South Wales, Journ. 45. pp. 67–75, 1912.)—The authors believe that the first stage in the process of rusting is the solution, to a limited extent, of iron in water, with the formation of ferrous ions. The hydrogen so produced, in the absence of free oxygen, polarises the iron surface; the function of oxygen is then the removal of the layer of polarising hydrogen. If this is so, contact with a more electronegative metal, like Pt, should increase the velocity of rusting. Experiments made to test this, using uniform steel strips fully immersed in unstirred distilled water, showed that such strips when connected with platinum rusted more rapidly than in ordinary circumstances. The steel used had the composition: C, 0·85 %; Mn, 0·61 %; P, 0·06 %; Si, 0·01 %; and S, 0·01 %. Experiments to test the influence of the composition of steel on the velocity of rusting in water containing 2·64 gm. of sodium hydrogen carbonate, 0·118 gm. of magnesium sulphate, and 0·166 gm. of sodium chloride per litre gave irregular results, from which few exact conclusions could be drawn. It was noticeable, however, that the initial rate of corrosion is very different from the rate which sets in after a few weeks, and that a steel containing 0·9–1 % of carbon rusts to a lesser extent than steels containing a smaller percentage of carbon. Magnetisation has no noticeable effect on the corrosion of a steel of the composition given above. In discussing the work of Heyn and Bauer on corrosion, the authors state that the accelerative effect of salts on corrosion is explained by the greater conducting power of the solution, and that the decrease in the velocity of rusting with higher concentrations is probably due to the decreased solubility of oxygen in the solution. T. S. P.

1298. *Solubility of Radium Emanation. Application of Henry's Law at Low Partial Pressures.* **R. W. Boyle.** (Phil. Mag. 22. pp. 840–854, Dec., 1911.)

1299. *Comparative Experiments on the Oxidation of Nitrogen in the High-tension Flame.* **M. Tausent.** (Zeitschr. Elektrochem. 18. pp. 314–319, May 1, 1912.)—The author tries various arrangements of the alternating-current arc; vertical arcs give better yields than horizontal arcs and are more stable. A simplified arrangement after Grau and Russ is described and recommended for the laboratory. H. B.

1300. *Atomic Percentages and Percentages by Weight in Metallographic Diagrams.* **F. Hoffmann.** (Metallurgie, 9. pp. 324–327, May 22, 1912.)—This paper forms an explanatory note to the author's earlier one [see Abstract No. 770 (1912)], and the advantages of plotting equilibrium diagrams on an atomic percentage basis over the percentage by weight basis are pointed out to metallographists. F. C. A. H. L.

1301. *Molecular Refraction, Molecular Volume, and Dissociation in Non-aqueous Solvents.* **F. Rohrs.** (Ann. d. Physik, 37. 2. pp. 289–329, Feb. 20, 1912. Extract of Dissertation, Rostock.)—The original pages should be consulted for the results, which are given in tabular form.

1302. *On the System Sulphur.* **A. Smits** and **H. L. de Leeuw.** (Konink. Akad. Wetensch. Amsterdam, Proc. 14. pp. 461–468, Nov. 22, 1911.)—An account of a further investigation of the behaviour of sulphur, in continuation of that dealt with in Abstract No. 690 (1911). L. H. W.

1303. *Ternary Alloys of Silver, Tin, and Lead.* **N. Parravano.** (Accad. Lincei, Atti, 21. pp. 575–581, May 5, 1912.)—A continuation of the author's thermo-analytical investigation of this system of metals. [See also Abstract No. 714 (1911).] W. H. Si.

1304. *Theory of Emulsification.* I. **W. D. Bancroft.** (Journ. Phys. Chem. 16. pp. 177–233, March, 1912.)—The first instalment of a monograph which must be consulted in the original. T. M. L.

1305. *Application of Theory of Chemical Potential to Thermodynamical Theory of Solutions.* Part I. *Osmotic Pressure and Vapour Pressure of Solutions.* **S. A. Shorter.** (Phil. Mag. 22. pp. 933–942, Dec., 1911.)—Theoretical.

1306. *Electrolytic Preparation of Persulphate.* **A. Blumer.** (Zeitschr. Elektrochem. 17. pp. 965–966, Nov. 15, 1911.)—Notes on the processes of G. Levi, the Konsortium für Elektrochemische Industrie and the Vereinigte Chemische WerkeA.-G. The experiments were made with an anode suggested by M. Le Blanc, consisting of four rings of Pt-wire, held by a skeleton-cylinder of glass rods, and two electrode tubes of mercury. H. B.